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MAY, 1935

400 West Madison Street
Chicago, Illinois

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Construction Under the Work-Relief Bill

THE Emergency Relief Appropriation Act of 1935, known also by the shorter designation of Work-Relief Bill, is now a law.

¶ Several of the earmarked appropriations that help to make up the huge total are of particular interest to the concrete construction industry.

¶ Highway and street construction and grade-crossing elimination are given an allocation of \$800,000,000.

¶ Low-cost housing, including subsistence homestead developments and slum clearance projects, is given \$450,000,000.

¶ Sanitation, flood and soil control, rivers and harbors—involving the construction of structures such as sewage disposal plants, dams, relocation of highways and bridges, and waterfront construction—are allotted \$350,000,000.

¶ For loans and grants to states, counties and cities, the sum of \$900,000,000 is set aside—and much of this will be expended on structures.

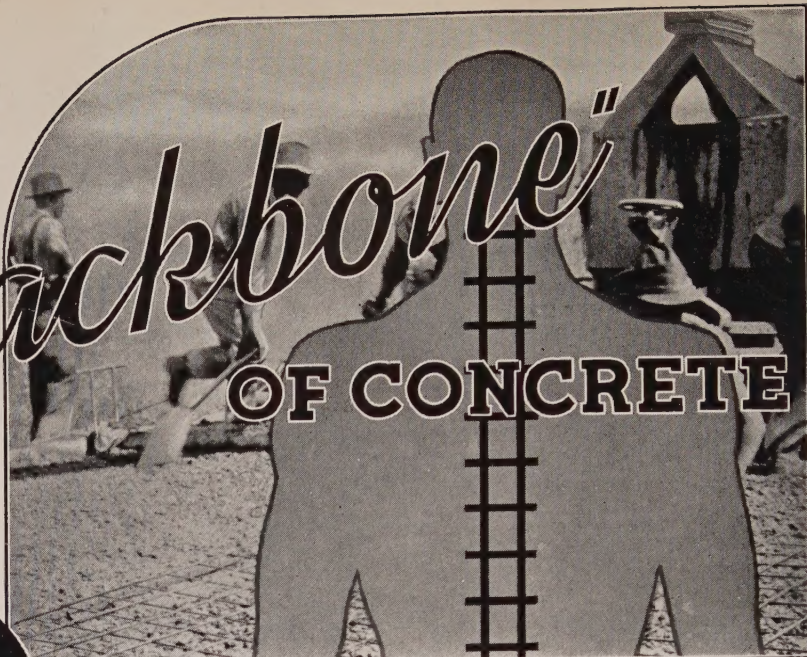
¶ The foregoing sums bring the total earmarked appropriations to \$2,500,000,000 for the construction of work in which concrete is certain to play an important part.

¶ The construction industry in general, and the concrete construction industry in particular, must share in the responsibility of making this great undertaking a success.

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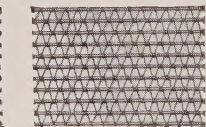


THE successful bidder on any paving job faces the task of keeping up to schedule if profits are to be fully protected. Delay in the delivery of materials—orders not filled to specifications—a lack of uniformity in the finished product—these are sufficient to defeat any program of planned economy. As a safeguard, choose the source of supply that builds Wire Fabric to the recognized high standard established for all American Steel & Wire Company Quality Products. This precaution will also assure on time deliveries. We have three mills manufacturing Wire Fabric and they are strategically located to render prompt service. American Steel & Wire Company Wire Fabric has repeatedly demonstrated its ability to develop the same unit stress for a constant applied wheel load. In addition—its use "ties" together cracks—thus safeguarding against "free" edge and other costly mishaps. An interesting booklet entitled "Reinforced Roads and Streets" will prove of much interest to engineers, contractors and road officials. Your request will bring a copy.

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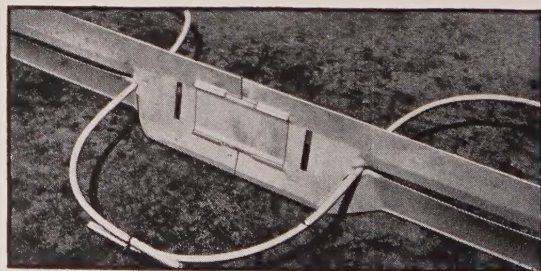
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Winter Paving Project in Illinois Removes Bad Traffic Jam

Construction Procedure in Detail—Heated Water and Heating Torch at Mixer Provide Warm Concrete—Subgrade and Finished Pavement Covered with Straw

THE crossing of Illinois Route 1 (Halsted Street) over the B. and O. C. T. railroad tracks near 135th Street, in Riverdale, a Chicago suburb, has long been an annoyance to the heavy traffic which uses Route 1. This traffic in 1931 averaged about 7,500 vehicles per day, and was approximately twice that on an August week-end day.

The highway at this point crosses the west end of the railroad's Riverside yards, and frequent switch movements cause serious delay and congestion of traffic.

A Nightmare to Highway Traffic

In 1934 a reinforced concrete grade separation structure, consisting of nine T-beam spans carrying a 40-ft. pavement and two sidewalks, was constructed over the railroad tracks. The topography being flat, it was necessary to fill in and repave the approaches for a considerable distance at each end of

the structure to join the required elevation.

The structure was completed and the fill placed and consolidated late in 1934. During construction, traffic was routed over an old two-lane pavement, underneath one of the spans and thence to the north end of the new fill over a temporary gravel surface that was with difficulty maintained in passable condition under this heavy traffic.

At best the detour provided only two lanes for use, compared with a four-lane highway at each end. Aside from this, maintenance work on the gravel often blocked one of these lanes, making necessary a one-way-at-a-time arrangement.

Winter Paving, Early Opening

To bring this situation to an end, as quickly as possible, the specifications for paving the approaches to the structure contained special provisions that required the contractor to proceed with

paving operations during the winter season, eliminating the usual restrictions which prohibit placing of pavement when the air temperature was 40 deg. F. and falling. The standard specification requirement that the temperature of the concrete in the drum be at least 60 deg. F. remained in effect, as did the requirement that the concrete be covered with a 12-in. layer of loose dry straw for 10 days after placing.

Paving was started on November 19 and proceeded as shown in Table 1, which also shows the average air temperature during the hours when paving was being placed. Temperature of the mix ranged from the specified minimum of 60 deg. to a maximum of 77 deg. F.

As Table 1 shows, little work was accomplished during the month of December. This was due to the unusual amount of snow and cold weather experienced in that month in the Chicago region, making December the severest month of the winter of 1934-1935.



Fig. 1 (Left)—After removal of straw covering from subgrade, the softened part of the subgrade was removed and replaced with cinders. Fig. 2 (Right)—A heater mounted on the side of the mixer heated the mixing water

TABLE 1

Date	Square yards of pavement laid	Average air temp. during paving, in deg. F.
Nov. 19	216	62
20	395	63
23	598	36
24	384	40
26	160	40
27	973	49
28	662	48
30	422	47
Dec. 1	798	34
5	306	33
18	407	36
Jan. 3	73	29
7	776	44
9	841	40
10	1,173	36
11	858	34
12	765	33
Total	9,807	

Prevent Freezing of Subgrade

The specifications prohibited the placing of concrete on a frozen subgrade. It was important, therefore, to prevent the subgrade from freezing at any time; for had it once become frozen, this condition would have prevented the placing of concrete for some time, even though conditions might have been favorable in other respects. To avoid such a situation, the entire subgrade was covered with a 12-in. layer of straw. Just before a paving operation started the straw was removed from the immediate area involved. Without exception, it had been effective in the prevention of freezing, but it did permit the subgrade to become soft and muddy.

As a means of correcting the condition created by a soft and muddy subgrade, all free water and mud were removed and the proper subgrade contour was restored by filling in with

clean, dry cinders. The cinders were hand-tamped to produce a dry, solid subgrade. This entire operation, including removal of the mud and water and the placing and tamping of cinders, is shown in Fig. 1. Thereafter, the transverse and longitudinal joints, the marginal bars and the tie bars were placed, and the concrete was deposited and finished as usual.

Only Mixing Water Is Heated

The aggregates—crushed limestone and torpedo sand—were proportioned by weight at a quarry about seven miles from the paving project. They were not heated. The water alone was heated, to about 100 deg. F., by passing it through an oil-fired heater mounted on the side of the mixer (See Fig. 2). Further heat was applied by means of an oil-fired torch within the mixer drum.

Fig. 3 shows the subgrade as finally prepared to receive concrete, while in the distance the concrete placed the previous day is covered with a 12-in. layer of straw—the same straw that previously had protected the subgrade.

The 216 sq. yd. of concrete placed on November 19 had a cement content of 1.96 bbl. per cu. yd. of concrete, and a water content of 4.64 gallons per sack of cement. The purpose of this rich mixture and the low water-cement ratio was that of insuring an early high strength of concrete that would permit the prompt opening of this part of the pavement to traffic, thereby relieving a situation that was causing congestion at the intersection with 138th Street.

Testing the Specimens

Six test specimens from this rich-mixture concrete were made in the form of 6 by 6-in. beams, 30 in. long, and

were broken at the age of 4 days. The specimens were broken in flexure, with center loading, on an 18-in. span, in a hand-operated testing machine. The machine, designed by the Illinois Division of Highways, is so arranged that a dynamometer reading gives directly the modulus of rupture for a 6 by 6-in. cross-section. Inasmuch as the cross-section seldom measures exactly 6 by 6 in., it is measured at the point of break and a correction factor is applied to the dynamometer reading to get the true modulus of rupture.

The twelve breaks obtained from the six specimens tested at the age of 4 days disclosed values of modulus of rupture ranging from 760 to 919 lb. per sq. in., and averaged 821 lb. per sq. in. The practice in Illinois is to open a road to traffic when the modulus of rupture has attained a value of 650 lb. per sq. in. or more; in consequence, it is probable that this rich-mixture portion of the road could have been opened earlier, had the tests been made sooner. As it was, this 4-day test, made on November 23, was made on a Saturday, and that made it possible to relieve the congestion at the intersection in time for the heavy week-end traffic.

The dynamometer used on the testing machine has a maximum capacity of 1,000 lb. per sq. in. Beams that do not break at a modulus of rupture less than 1,000 lb. per sq. in. are recorded as failing at that point. At the age of 14 days, two of the tests did not produce a break in a beam made from the concrete placed during the first day's operations (on November 19).

High Strength of Concrete

Aside from the 216 sq. yd. of pavement placed at the intersection with 138th Street, the cement content on this project was 1.45 bbl. per cu. yd. of concrete in place, and the water content was 5.40 gallons to the sack of cement. Most of the test specimens made from this ordinary mixture of concrete—eight specimens per day on November 20 and 23, and four per day thereafter—were broken at the ages of 3, 5, 7 and 14 days. The average modulus of rupture for the various ages will be found in Table 2.

TABLE 2

Age of test specimen, in days	Average modulus of rupture, lb. per sq. in.
3	478
5	673
7	881
14	910

(Continued on page 28)

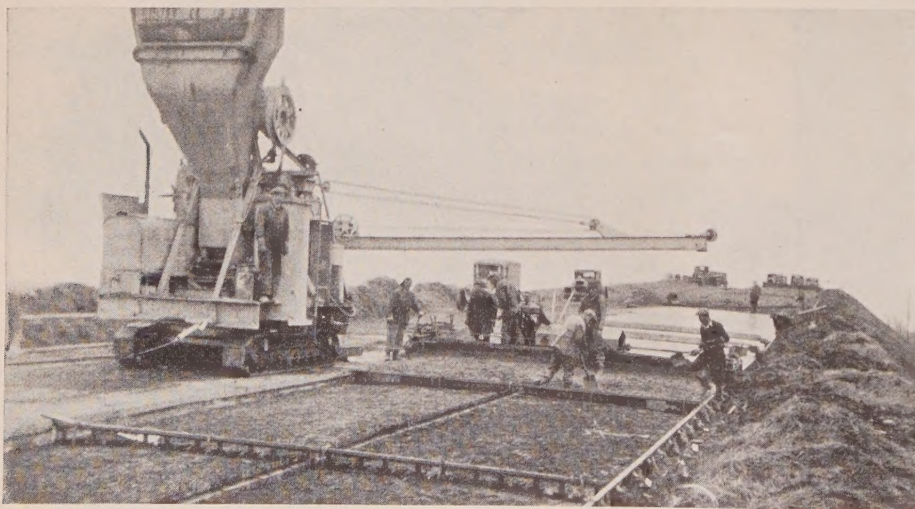


Fig. 3—In the foreground is the subgrade as finally prepared. In the distance the concrete placed during the previous day is covered with 12 in. of straw

Resurface Huge Industrial Building with Reinforced Gunite

American Meter Company Building in Albany Now in Superior Condition—White Cement Produces Attractive Finish—The Working Procedure

A NEW exterior face of reinforced gunite, with white portland cement in the final coat, has restored the 4-story American Meter Company Building, at 995 Broadway, in Albany, N. Y., to an appearance far more attractive than the building possessed when it was first occupied some years ago.

Structural Condition Improved

From the structural standpoint also, the building is now in a condition superior to its original condition. In a structural sense this large reinforced concrete industrial building, erected as a closed quadrangle around a square inner court, had in no way deteriorated throughout its interior construction. The inferior quality of the concrete in the exterior walls, however, had permitted some disintegration to take place. This was shown, for instance, in the concrete window sills, which had disintegrated to a considerable extent. Many of the wall columns showed spalling in the exterior corners. Careless placing of steel reinforcement had resulted in getting some of the bars too near the exterior surface of the wall columns, and these bars had rusted, spalling off the thin coverings of concrete because of the expansive power of the rusting steel.

Now, with a new exterior shell, or armor, of reinforced gunite, the building has an attractive and weather-resistant exterior that is greatly superior to the original exterior surface, while the interior structural floors and columns remain as sound as they were from the beginning. In consequence, the condition of the remodeled building is definitely an improvement over its original condition.

Gunite Operation in Detail

Architects as well as contractors will be interested in the exact working procedure followed in applying this new surface. How, for illustration, was the old surface prepared—and what was done to insure a thorough bond between the old surface and the new gunite coating?

The original surface was prepared by chipping off all concrete that had started to disintegrate; and at points where steel bars became exposed the concrete was chipped out behind the bars so the latter could be sand-blasted all around. The entire surface was then sand-blasted, to remove all dirt and all loose or disintegrated material remaining.

The sand-blasting was done with the regular cement-gun equipment—that is, with the same equipment that later placed the coatings of gunite.

Attaching the Wire Fabric

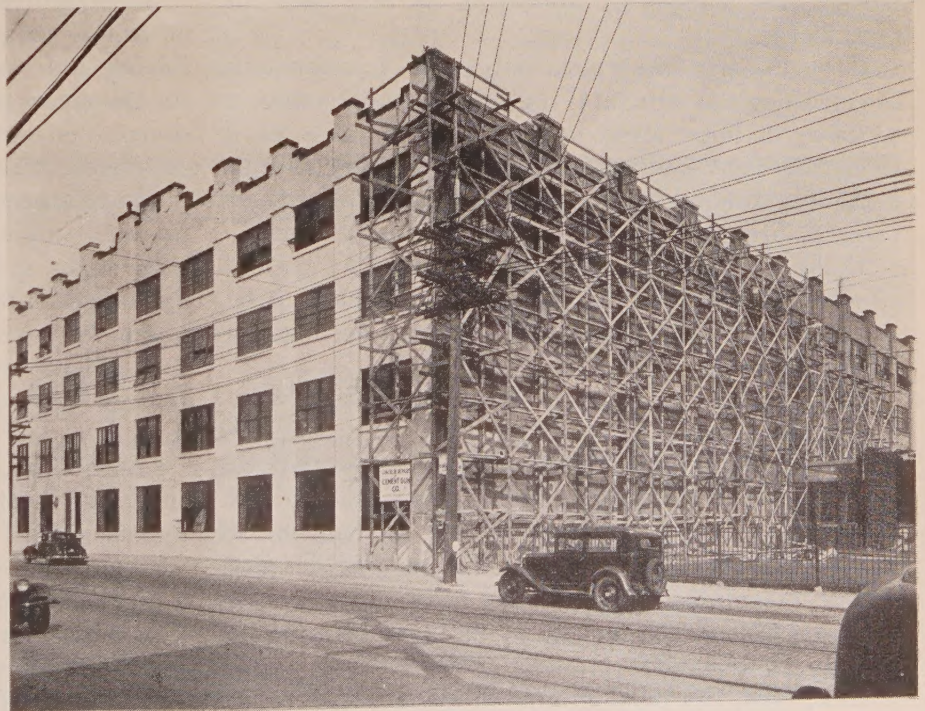
Welded galvanized wire fabric was then attached to the exterior, held at a distance of $\frac{1}{2}$ in. from the surface. This fabric has a 2 by 2-in. mesh and is made of No. 14-gage wire. It was fastened to the surface by means of $\frac{1}{4}$ by 2-in. expansion bolts set in the old surface at vertical and horizontal spacings of 24 to 30 in. The fabric was bent around corners in sharp 90-deg. bends.

It should be stated that, while on this work the old surface was sand-blasted *before* the welded wire fabric was placed, sand-blasting may be done *after* the fabric is placed. That is, the placing of the wire fabric need not be delayed, in the event of delay in sand-blasting operations.

Next the "shooting strips" of wood were placed, to serve both as screeds and as lines of demarcation. Then the entire surface was washed with clear water, applied under pressure through the nozzle of the cement gun. Thus the same "shooting" equipment was used for sand-blasting, for washing the surface, and for applying the gunite. This washing of the surface removed all traces of dirt or loose particles.

The First Coat

The gunite was applied in two coats—a first coat and a final, or flash coat. The first coat was of ordinary gray portland cement and graded sand passing the No. 4 sieve, mixed in the proportions of 1 to $3\frac{1}{2}$. It was shot on to



Gunite resurfacing of American Meter Company's manufacturing building in Albany, N. Y., puts structure in condition superior to its original condition. White cement was used in the final coat

a thickness of $\frac{3}{4}$ to $\frac{7}{8}$ in., so that it covered the welded wire fabric to a depth of $\frac{1}{4}$ to $\frac{3}{8}$ in. The shooting of the first coat was followed within 20 to 30 minutes by the cement finishers—though the finishing in this case is quite different from ordinary cement finishing. Here the finishers worked with a special steel cutting edge which cut off the high spots and irregular parts of the surface and left a surface that was true to line but of a rough texture, thus forming a good mechanical key for the final coat. This texture was obtained by a sawing motion of the tool.

The first coat was kept damp by spraying with hose every hour or two for a period of 48 hours, before the final coat was shot on; and it was washed with clear water, again applied under air pressure by the cement gun, just before the final coating was started.

Final Coat and Finish

The final, or flash coat, then was shot on, to a thickness of $\frac{1}{4}$ in., though in no case was this operation started until the entire area of a separate section of the wall was ready. This final coat consisted of Atlas white portland cement, mixed with graded sand passing the No. 8 sieve, in the proportions of 1 to $3\frac{1}{2}$. These proportions were the same as for the first coat, though a finer sand was used.

An attractive finished texture was obtained by the use of irregular handfuls of gunny sacking, with which the surface was rubbed in a circular motion. Very little pressure was applied, so as not to dislodge particles of sand. The final coat then was kept moist for a period of 48 hours, again by spraying with hose.

The illustration shows this work com-

pleted on one side of the building (at the left), and in progress at the side on the right.

Acknowledgment: This resurfacing work on the American Meter Company's building was placed by the Cement Gun Company, of Allentown, Penna.

Leipzig Fair Successful

THE Leipzig Fair, just concluded, was the largest and best attended in several years, indicating a general revival in world trade. According to the official reports 180,000 buyers visited the Spring Fair, an increase of 40,000 over last year, of whom 21,000 were from foreign countries, an increase of 25 per cent over 1934. The United States sent 356 buyers representing a wide range of business interests. Seventy-four countries in every corner of the world were represented at Leipzig this year.

Hitch Your Wagon to This House-Building Star

(An Editorial)

HOME construction is coming back on a large scale. In addition to the \$450,000,000 ear-marked for low-cost home construction in the new federal work-relief bill, and the higher type of home construction being stimulated by the FHA, private enterprise has begun to take hold. This last assertion is well supported in an article headed "Low-Cost Fireproof Homes Are With Us," appearing in this issue of CONCRETE.

Very properly, the Portland Cement Association is broadcasting the structural and architectural value of concrete in home construction. This is quite as it should be, for to this association belongs much of the credit for awakening the public consciousness of the value of fireproof construction for the small home.

Much of the Portland Cement Association's present effort is directed toward the creation of sentiment favoring monolithic concrete wall construction, together with concrete floors, partitions and roofs.

There will be no let-up in the dissemination of information on other forms of concrete construction in home building, such as concrete ashlar masonry, and the like; but in the larger campaign just inaugurated, monolithic concrete construction will be emphasized as a rugged material capable of withstanding the most violent assaults of the elements—fire, water, storm and quake—and yet capable of the most pleasing architectural treatment.

How, then, can other groups in the construction industry tie into this monolithic concrete house campaign of the Portland Cement Association, to the benefit of everyone, including the home-owning public?

The ready-mixed concrete industry, co-operating with local groups of contractors, will be one of the first to benefit from the spread of monolithic concrete home construction. Here lies a new outlet for their material—one that involves also the development of convenient and inexpensive means of handling and distributing the concrete on the job.

Manufacturers of concreting equipment may hitch on to this campaign with the development of concrete mixing and conveying equipment designed especially for the small job—equipment that will mix job-made concrete effectively and deliver any concrete, whether job-mixed or ready-mixed, to the top of the walls.

Manufacturers of special forms, such as metal and plywood and related materials, and makers of concrete form specialties, can help the cause and help themselves at the same time by giving particular attention to the requirements of the small job.

Associations and companies in the field of reinforcing steel obviously have a very important part to play in this campaign.

In all cases, the equipment must be adapted to the small construction project. It must be as light and as inexpensive as possible, without being inefficient.

Manufacturers of concrete products, likewise, have a place in the campaign for monolithic house construction, particularly in the production of precast concrete joists for floors, light-weight units for partitions, and furring units for interior finish.

Finally, the magazine CONCRETE will perform its duty, by publishing information on the best and most economical methods of design and construction.

Low-Cost Fireproof Homes Are With Us



Hundreds of Concrete Homes Built Last Year Prove That Builders Have Found the Way—Antiquated Ideas and Methods Are Being Discarded

THE low-cost fireproof concrete home has become a fact. Several hundred attractive concrete homes of various types, built within the past year, testify to the truth of this claim.

The home-building and home-owning portions of the American population are at last growing conscious of the great truth that fireproof construction is just as important for individual small homes as for hotels, apartment buildings and office buildings.

Until recently, the question of cost was the shadow that frightened many. This fear gave rise to the unfounded belief that fireproof construction, though desirable, would be prohibitive in cost for the small home—a belief that began to be dissipated with the advent of the concrete first floor. At a small additional cost, this type of floor provided protection from basement fires.

While the reinforced concrete first floor was a big step in the right direction, the first and second-story partitions, the second floor and the roof remained of combustible construction. So long as this condition prevailed, the danger from fire was not removed—it was only reduced.

Eliminating Cost of Plastering

Finally, the home-building element of the population began to see that fireproof construction was not the only feature that might be borrowed from larger buildings. In theatres and club buildings, more especially, progressive and courageous architects had dared to spurn old traditions—they began to omit interior plaster work, by direct decoration of the surfaces formed by the plastic material, concrete. Why, then, could not these same economies be realized in the construction of the small home?

The answer to this question was soon found—they could. The concrete floor, when built of precast reinforced concrete joists and cast-in-place slabs, provided a monolithic floor that automatically invited a beamed-ceiling method of treatment for the first and second-

story ceilings—with the decorative paints and stains applied directly on the concrete surfaces.

Low-Cost Concrete Floors

From the standpoint of economy the precast reinforced concrete joist also proved a winner; for here, at last, was a fireproof floor which cost no more than a wood-joisted floor when the completely finished floor and ceiling construction was taken into account. Figure 1 illustrates this important point. A true comparison between the two floor types is obtained only from the completed construction, in which the greater cost of the structural concrete construction is more than balanced by the saving in the ceiling treatment and in the floor finish. On the other hand, if a flat plastered ceiling is desired, it can be attached to the precast joists in the usual way.

Concrete Ashlar Replacing Plaster

In the meantime another new development in the concrete products industry made it possible to eliminate the cost of interior plaster work on vertical surfaces, just as precast concrete joist construction had eliminated it from the

ceilings. This new development was the concrete ashlar masonry unit, which, when decorated direct, produced a surprisingly attractive surface finish for walls and partitions.

Now, even more recently, renewed interest in monolithic concrete for exterior walls, with or without exterior stucco, promises a still wider choice of the various forms of concrete construction in the building of low-cost fireproof homes.

Protection Against the Elements

The first thought in the mind of the owner or builder of a fireproof home is the desire to escape the danger of having his home destroyed by fire. Yet one of the most gratifying features about a fireproof concrete building lies in its ability to resist other elements equally well—elements such as frost, heat, wind and rain, and that destructive insect known as the termite. In consequence, durability and low maintenance costs take the place of the heart-breaking repair and maintenance expenditures to which the hard-pressed home owner has too long been accustomed.

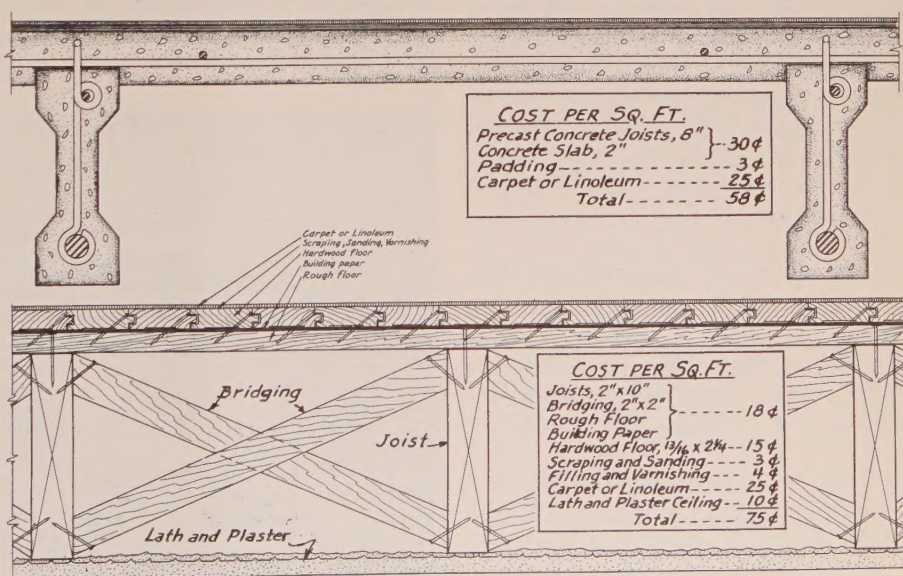


Fig. 1—Itemized comparison shows floor of precast concrete joists and cast-in-place slab the most economical type



Fig. 2.—This “home-keeping house” at Westport, Conn., built of concrete ashlar and concrete first floor, cost less than \$3,000, including heating and lighting and plumbing. Frank P. Bissell, architect

Low-Cost Homes a Fact

What, now, has been accomplished in the actual building of the low-cost fireproof concrete home? Have such homes been built at costs definitely below the costs prevailing during the building boom of the 1920's?

The answer to these questions is highly gratifying, for the year 1934, in particular, saw the construction of hundreds of modern homes at surprisingly low cost, through the simple expedient of taking full advantage of the properties of concrete and concrete products. In Miami Beach, Fla., for example, 200 of the 260 individual homes built in 1934 were of some form of concrete construction. A concrete home in Westport, Conn., illustrated in Figure 2, attracted 17,000 visitors and resulted in the sale of more than 100 sets of plans for a similar building. In one afternoon 4,600 adults visited a demonstration concrete home in Kansas City, and during a period of three weeks the number of visitors totaled 15,600. The house was sold on the second day. In Lexington, Mass., a 7-room concrete home of the Cape Cod type brought the architect two more commissions for buildings of a similar kind.

A Charming Home for \$3,000

The 5-room home at Westport, Conn., illustrated in Figure 2 and mentioned previously as having attracted 17,000 visitors, is worthy of special attention. Designed by Frank P. Bissell and known as the *Woman's Home Com-*

panion home, it was built by Martha Cobb Peabody, of the editorial staff of that magazine, for less than \$3,000, including heating, lighting and plumbing. The exterior walls are of random ashlar cinder concrete masonry units 8 in. thick, the exterior and interior wall faces being coated with white portland cement paint. The first floor is of precast reinforced concrete joists and cast-in-place slab construction, with a finish coat of red portland cement mortar marked off in squares, and waxed. The second floor and the roof rafters, and the first and second-story partitions, are of wooden construction—a fact that is unfortunate, since partitions of 3-in. or 4-in. concrete ashlar units, and a second floor of precast concrete joists, would

have added very little, if anything, to the cost. The roofing shingles are of cement-asbestos, and windows have steel sash.

The Floor Plan

The ground floor of the 5-room home just described has a spacious living room, modeled after the old-fashioned “keeping room” of our forefathers, with a large kitchen range occupying the center of one side and supplying not only the heat for cooking and for hot water, but for heating the whole house. In plan, this room is 13 by 20 ft.; and on this same floor is a bed room 12 by 12 ft., with a closet, a large entry and a bath room. Two bed rooms on the second floor are each 12 by 12 ft. in plan, each served by a closet.

An alternate plan of a more usual arrangement provides, on the ground floor, a living room 12 by 20 ft., a kitchen 8 by 12 ft., a pantry, and a bed room 12 by 12 ft., served by a closet. On the second floor is a bath room, and two bed rooms each 10 by 12 ft. in plan and each served by a closet.

More Low-Cost Homes

A somewhat more pretentious design is the home illustrated in Figure 3, designed by C. F. Rosberg, architect, for Charles G. Schmidt, of Lynbrook, Long Island, N. Y. This 5-room home and attached garage, built at a cost approximating \$5,000, has walls of concrete masonry units. The exterior is finished with white portland cement paint, and the interior is finished in exposed cinder concrete ashlar furring block. The floors are of concrete.

Most of the 200 concrete homes previously mentioned as having been built

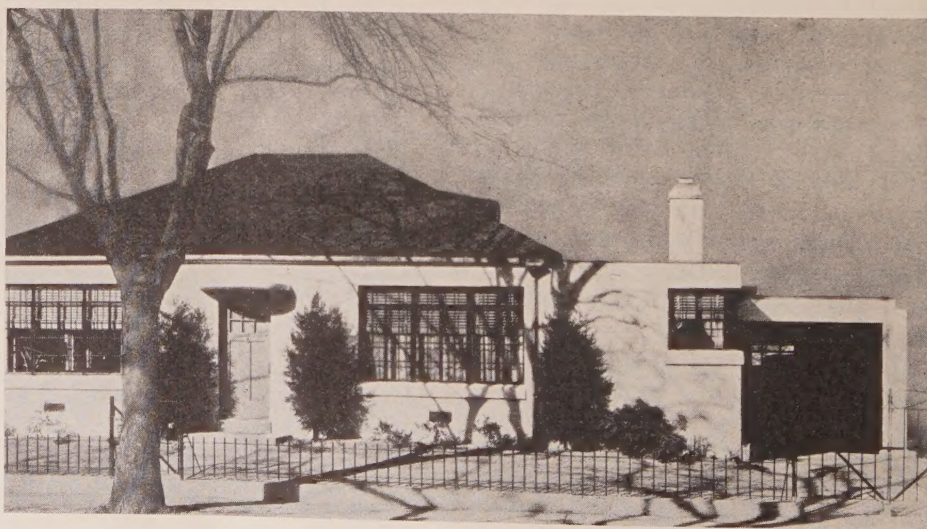


Fig. 3—Concrete home on Long Island, with five rooms and an attached garage, cost \$5,000. C. F. Rosberg, architect



Fig. 4 (Left)—A 7-room concrete home and attached garage in Lexington, Mass., built at cost of \$6,000, won two additional commissions for the architect, Charles M. Willis. Fig. 5 (Right)—Concrete house and attached garage in Detroit, built last year, sold for \$4,000. Albert Bill, architect

in Miami Beach, Fla., during 1934, are practically 100 per cent concrete. The frames are of reinforced concrete, with concrete masonry filler walls. Floors and roof are also of concrete construction, mainly with precast members.*

Architect Wins More Commissions

Figure 4 illustrates a most charming 7-room concrete house of the Cape Cod type, designed by Charles M. Willis, architect, and built at Lexington, Mass., at a cost of \$6,000, including the cost of a 2-car garage. The house has a full basement. The walls are of concrete masonry coursed ashlar units, 8 in. thick, and the outside surface was given

two coats of white portland cement paint. This cottage attracted so much favorable attention that the architect received commissions to design two more houses of the same type, both of which were built with concrete ashlar walls and painted surfaces.

Detroit Home for \$4,000

Figure 5 shows a small concrete home built in Detroit last year, which, together with the attached garage and the lot, was sold for \$4,000. The walls of this house, which is located at 2725 Oakman Court, are built of coarsed concrete ashlar, the exterior surface being coated with white portland cement paint. Albert Bill, of Detroit, is the architect.

A 5-room concrete home of the modern flat-roof type, with a built-in garage, was built in Indianola, Iowa, in 1934 at a cost of \$2,700, including heating, lighting and plumbing. Exterior walls and partitions throughout are of concrete masonry units, while the first and second floors and the roof deck are of precast concrete joist construction, all of which produces a completely fire-resistant type.

The Red House Home

A type of low-cost concrete home having great possibilities in connection with large developments is shown in Figure 6. This is one of a hundred of this type being built at Red House Gardens, West Va., in a subsistence homestead project of the federal government. This house has cinder concrete masonry unit walls, coated with white portland cement paint. The interior is finished with a colored mortar which is applied with a trowel and produces an interesting textured effect. These houses are costing from \$1,800 to \$2,500, though this price includes $\frac{3}{4}$ of an acre of land and a small barn. The living room, 11 ft. 6 in. by 18 ft. 8 in., is along the front. At the left rear is the combined dining room and kitchen, 10 ft. by 18 ft. 10 in. A bed room in the rear wing at the right measures 10 ft. 2 in. by 13 ft. 4 in., and between it and the dining room is a bath room. A stairway leads to a spacious unfinished attic, which provides ample sleeping quarters.

Thus it is demonstrated beyond question that modern fireproof concrete homes can be built at low cost, if the builder discards antiquated ideas and methods and utilizes the properties of concrete to the fullest extent.



Fig. 6—One of a hundred concrete homes in Red House Gardens, West Va., a government subsistence homestead project, being built at costs ranging from \$1,800 to \$2,500, including $\frac{3}{4}$ acre of land and a small barn

*This type of construction is to be described in detail in an early issue of CONCRETE.

Cost of Raising Settled Road Slabs

Ten Maintenance Crews in Illinois Keep Detailed Cost Data on All Phases of Mud-Pump Operations

TABULATION of the monthly field mud-pump operation reports from the ten outfits used on the Illinois state highways during 1934 shows the following results:

Number of settlements raised.....	2,484
Sq. yd. of pavement raised.....	202,046
Average direct cost per sq. yd. \$	0.296
Cu. yd. of pavement depressions filled	6,835
Cost per cu. yd. of pavement depressions filled	\$ 8.78
Number of holes bored in pavement	50,753
Average direct cost per hole	\$ 0.11
Pavement expansion joints cut	605
Cost per joint (Average pavement width—18 ft.)	\$ 3.59
Cu. yd. of earth pumped	12,578
Cost per cu. yd. (including hauling) \$	2.88
Cement used (sacks)	8,053
Cost per sack	\$ 0.46
Sq. yd. of asphalt patches removed from pavement surface at depressions	25,673
Cost per sq. yd. (removing asphalt) \$	0.11
Total direct expenditure for year.....	\$59,996.48

The field reports include direct costs only, such as labor, field supervision, gasoline, oil, repairs, moving expenses, field expenses, and field storages. No machinery rental or depreciation is included.

The cost per square yard is the total expenditure divided by the number of square yards, and the cost per cubic yard of pavement depressions filled is obtained the same way.

What the Costs Include

The cost of boring holes includes the cost of operation, repair, moving and field storages of the air compressor, and the wages and expenses of the men. The expansion joints are figured on the same basis. The cost per cubic yard of earth pumped includes the hauling of the earth and water and the pumping operation, with labor, expense and repair of the trucks, mud pump and water tank included. It excludes the other items listed.

Before the mud-pumping system was developed, pavement depressions were filled with bituminous mixtures, and this method is still used for immediate and temporary repairs when a mud pump can not be promptly sent to the location. The cost of removing these asphaltic patches is counted into the cost of the pavement-raising operation.

The patches are usually removed with the air compressor outfits.

It will be noticed that the amount of earth pumped is almost double the amount of pavement depressions filled. The measurement is taken in the trucks and the shrinkage is due to the bulking action of the loose earth, the voids found beneath the pavement, and the wastage and losses unavoidable in the operation.

Equipment and Crews Required

The equipment used for one mud pump outfit consists of one mud-pump, one 200-gallon or 300-gallon water tank mounted on a trailer, one or more water supply tanks for use at the site of the job, two trucks for hauling earth, one truck for general utility and water hauling, one air compressor of 120 to 160 cu. ft. capacity, one paving breaker and one or two drills. The trailer-mounted water tank is equipped with a small centrifugal pump operated by a 1½-hp. gasoline engine, to be used for filling the tanks.

A crew of eight or nine men is usually employed for operating the outfit. These consist of one foreman, two air compressor men, one mud-pump operator, one nozzle man and one shoveler, as a regular crew. The other two or three men are picked up at various locations where the work is in progress. Where the crew is operating on a road which carries heavy traffic, it is sometimes necessary to employ additional men as flagmen; and when it is necessary to send a considerable distance to get suitable earth, one or more extra shovelers are employed.

During the first year of the operation of these outfits, it was found that there was considerable wear on the mud-pump hose due to dragging it along the pavement. The weight of the hose filled with mud is considerable, and in addition to causing extra wear, men were required to assist the nozzle operators in dragging the hose from one hole to another. This has been taken care of by placing the hose on two or three dollies, which are mounted on three-wheel castors.

General Supervision

General supervision of the outfit is handled by a field engineer of the maintenance department, who selects the routes, marks the locations, keeps the crew supplied with the necessary equipment and repairs, and keeps records.

In case of slight depressions on straight grades, efforts are made to bring the pavement back to the original grade line; but on long, irregular depressions efforts are directed at obtaining a smooth riding pavement without particular reference to the original grade line. One district reported raising two depressions that were 24 in. in depth.

In addition to raising the pavements where settlements have occurred on fills, the mud pumps have also been used for adjusting pavements at a few grade crossings.

Acknowledgment: For the very useful and practical information contained in this article, CONCRETE is indebted to Ernst Lieberman, chief highway engineer, Illinois Division of Highways, and to Fred Tarrant, engineer of maintenance, Illinois Division of Highways, Springfield, Illinois.

Coming Conventions

May 2-3—Associated General Contractors of America. Annual Spring Meeting. Washington, D. C. E. J. Harding, Managing Director, 222 Munsey Bldg., Washington, D. C.

May 4-12—San Francisco Builders Exchange. Annual Building Exposition and convention. Civic Auditorium. Frederick Weddleton, 644 Mission St., San Francisco, Calif., Manager.

May 6-10—American Water Works Assn. Annual. Cincinnati, Ohio.

May 15-17—The Cast Stone Institute Conference and Exhibition. U. S. Chamber of Commerce Bldg., Washington, D. C. C. G. Walker, Asst. Secy., 33 West Grand Ave., Chicago.

May 27-29—Building Officials' Conference of America. Annual meeting, Indianapolis, Ind. Wm. F. Hurd, Secretary, Building Commissioner's Office, City Hall, Indianapolis.

June 11-14—The Special Libraries Association. 27th Annual. Hotel Statler, Boston. W. N. Seaver, for the Science-Technology Group, Cambridge, Mass.

June 24-28—American Society for Testing Materials. 38th Annual Meeting and Exhibit of Testing Apparatus and Related Equipment. Book-Cadillac Hotel, Detroit, Michigan. R. E. Hess, Asst. Secy., 260 South Broad Street, Philadelphia, Pa.

July 3-5—American Society of Civil Engineers. Annual. Los Angeles, California.

Oct. 14-18—National Safety Council. 24th Annual Safety Congress. Louisville, Kentucky. A. J. R. Curtis, 33 West Grand Avenue, Chicago, Secretary Cement Section.

Grand Prize Winner in Small-Home Class

Huge Number of Flat-Roof Home Plans Submitted in General Electric Competition Promises Well for Concrete House Construction

IT is of particular significance to the concrete construction industry that of the 2,000 plans submitted for the architectural competition sponsored by the General Electric Company in co-operation with the Federal Housing Administration, more than 1,500 were of the flat-roof type. These plans came from every state in the Union, so that they may be regarded as reflecting a cross-section of the architectural opinion of the entire nation. The modern flat-roof homes built at the Century of Progress, in Chicago, have accomplished their mission.

While many of the plans submitted did not indicate the kinds of construction material contemplated, it can be recognized at once that the flat-roof home, with its broad surfaces, lends itself particularly well to concrete construction—regardless of whether one thinks of concrete ashlar, concrete masonry coated with stucco, or monolithic concrete with or without stucco.

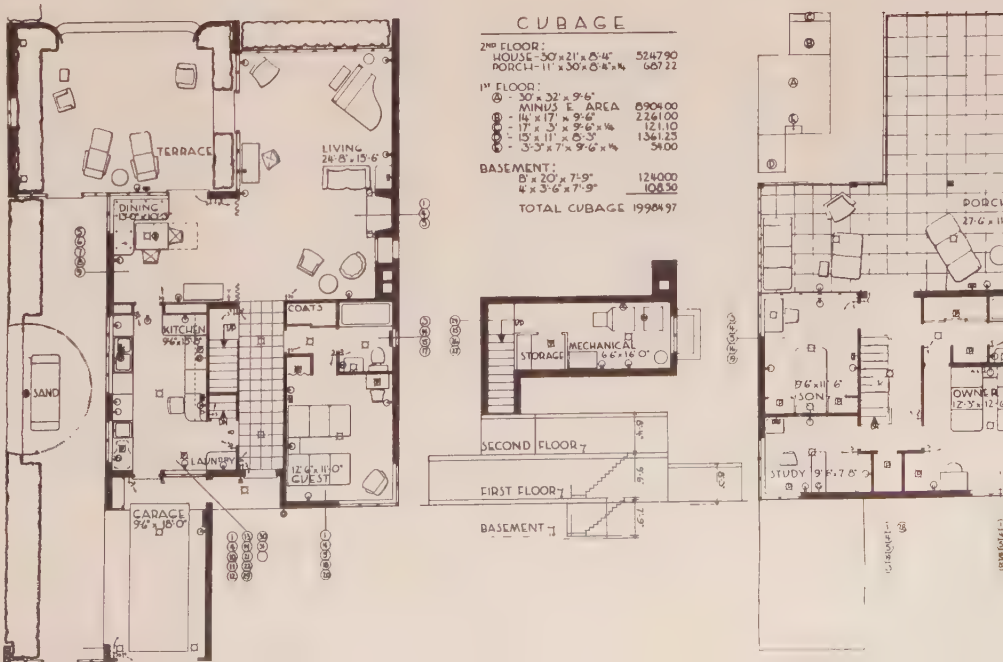
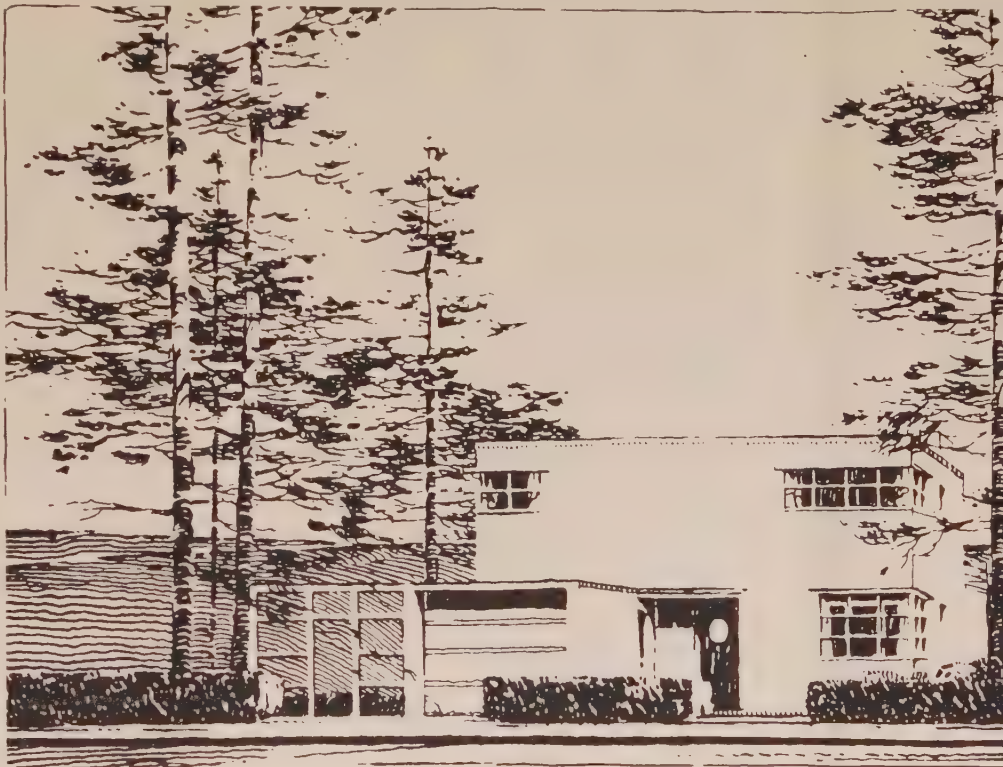
The Small-Home Winner

Most notable among the flat-roof house plans submitted is the grand prize winner in the small-home classification, here illustrated. Hays and Simpson, of Cleveland, winners of this prize, designed their home for a southern location, with a maximum of outdoor living.

The garage has been placed in front, permitting easy access to the street and allowing full utilization of the lot for lawn and garden. Terraces, porches, and play yards are incorporated in the design. The basement has been reduced to a minimum for heat and storage.

The guest room is located on the first floor, with the adjacent bath serving also as a first-floor lavatory. A large, flexible living room and dining room are at the rear, with a provision for dividing the room with curtains. Both rooms have access to the terrace, which invites outdoor dining and relaxation.

The owner's room and study-workshop occupy the front portion of the second floor, with a boy's room to the rear. A large, second-floor porch opens from the hall and has an open fireplace. The laundry and kitchen are combined, and can be reached directly from the garage.



Grand prize winner in the small-home classification in the General Electric Company's architectural competition. The flat-roof type is especially adapted to concrete construction. Hays and Simpson, architects, Cleveland, Ohio

Should Increase Allowable Stress in Steel Reinforcement

Report by Noted European Engineer Proves Fear About Excessive Cracks in Concrete to Be Groundless

By DR. FRITZ von EMPERGER
Consulting Engineer, Vienna, Austria

In the United States one of the most frequently recurring arguments against high working stresses in steel reinforcement is based on the erroneous supposition that the consequent elongation of the steel bars would cause the opening of excessively large cracks in the surrounding concrete, and that these cracks would expose the steel and lead to corrosion. This long-standing supposition has been based on nothing more substantial than opinion.

This controversial question is discussed by the noted Austrian engineer, Dr. Fritz von Emperger, in No. 16 of the reports of the Austrian Reinforced Concrete Committee, published by the Oesterreichischer Ingenieurs- und Architekten Verein (Austrian Engineering and Architectural Association), of Vienna.

With a letter to the editor of "Concrete," Dr. Emperger has kindly transmitted the following abstract of his paper.—The Editor.

THE writer's report—No. 16 of the reports of the Austrian Reinforced Concrete Committee—comprises a new departure in many respects with regard to reinforced concrete. It contains a series of important

suggestions for securing bond between steel and concrete and in regard to permissible cracks in reinforced concrete beams. It deals with the basis of adhesive strength, as against the usual method of computing bond, by proving that a properly designed reinforced concrete structure will show no sliding of steel in accordance with our usual assumptions.

Permissible Crack Widths

The local variations in the bond stresses and the mutual separation occurring with the exposure of the steel in the crack section are dealt with, as well as the influence of the plastic deformation of the concrete in connection therewith. By means of tests, the width of the steel exposure in cracks, as well as the width of the cracks at the surface, are measured. Thus the relation between the permissible stresses and the crack width is being established. Thereby the criterion for harmless and for dangerous cracks is set forth.

Superiority of Deformed Bars

Remedies are indicated by which the bond can be increased and the exposure of the steel in the cracks can be reduced, or even avoided. Of particular interest is the proof of the superiority of deformed bars such as are generally used in the United States. A series of American and British tests

are mentioned, as well as tests made in Europe with Isteg¹ bars, this being the type of deformed bar most commonly used in the continent of Europe.

Direct measurements are published in the report by which it is proved that by using deformed bars one can reduce the exposure of the steel by one fourth, and that, moreover, a greater number of deformation cracks are formed with the better bond. In this connection the report mentions tests of permanent loading executed by Prof. Graf. Stuttgart, which prove that plain round steel will vibrate out of the concrete where loadings are frequently applied,² and that, therefore, plain round steel bars should not be used for high stresses.

Allowable Stresses Should Be Higher

Taking as a point of departure the permissible stresses used so far, and the crack width corresponding to these stresses, the requirement set forth is that for higher allowable stresses. This crack width may be considerably exceeded. It is demonstrated in the publication (Report No. 16) that by improving the bond this is easily accomplished.

The publication presents for the first time a real criterion for permissible crack widths. It will therefore encourage the use of high-class steel and it will serve to eliminate unjustified prejudices, bringing allowable stress requirements to more sensible figures, as in the new British code of practice for reinforced concrete.

¹ A double-stranded twisted bar described on page 12 of the May (1934) issue of CONCRETE.

² As in the case of railway structures subjected to frequently applied loads accompanied by impact.—Editor.

Cast Stone Exhibition and Conference

AN exhibition of cast stone will be held May 15, 16 and 17 in Washington, D. C., at the U. S. Chamber of Commerce Building.

Concurrent with the exhibition, a conference of producers and users of cast stone is being held by request of the Cast Stone Institute under the auspices of the Division of Trade Standards, U. S. Department of Commerce, for the purpose of adjusting and accepting the Proposed Commercial Standard for Colors and Finishes for

Cast Stone and for the purpose of selecting standard samples of additional colors and finishes.

The exhibition is being sponsored by the Cast Stone Institute and will include samples, models and other exhibits from various cast stone plants.

In line with the increasing attention being given to concrete in architecture, the exhibits will illustrate and emphasize the conception and use of cast stone as a distinctive and refined form of concrete.

Of especial interest will be a model wall section showing the use of cast stone as the forms for monolithic concrete walls, the cast stone remaining in place as the exterior finish.

Samples made with surface color-coated aggregates and with manufactured ceramic and vitreous aggregates as well as many other novel ideas will demonstrate the progress being made.

Exhibits along technical lines will illustrate the marked advances made in physical strength by applying to cast stone the latest improvements in the art of concrete making.

EDITORIAL

Builders Have Found the Way

Architects and builders have found the way to the low-cost fireproof home—not through cheap or flimsy construction, but through the far more sensible plan of discarding outworn habits and methods, replacing antiquated ideas with modern conceptions of values.

Because for some thousands of years the inside walls and partitions of dwelling houses have been coated with plaster, we are under no obligation to continue that costly practice now that we have available a plastic material like concrete, the surface of which may be textured, stained and painted direct.

Because plastic and masonry materials, heretofore, have been confined mainly to the exterior walls of dwelling houses, there is no reason why these materials should not be utilized in the construction of floors and partitions. And because American house builders primarily have been carpenters for many generations, there is no reason why they can not transform themselves into concrete men. Or, if they refuse to transform themselves, they must be gradually replaced by a new generation of builders who are not afraid of new ideas.

Costly and wasteful methods in house-building must give way to the more economical methods which, during the past ten years, have slowly but surely taken root in the practice of progressive architects and home builders.

Free Superintendence on Architectural Concrete

An announcement elsewhere in this issue tells of the free services of experienced superintendents on monolithic concrete architectural work, now being supplied by the Portland Cement Association. This announcement is of the utmost importance to architects and contractors.

The construction superintendents which the P. C. A. has engaged for this work have devoted practically all of their construction career to this special field of architectural concrete. They have intimate knowledge of all phases of the work—the design and erection of forms and molds for architectural concrete, the mixtures of concrete best suited for various purposes, the best methods of placing architectural concrete, the curing of such concrete, and the protection of the work during other construction activities.

Architects may obtain the services of these men without cost, for consultation during the designing and detailing of architectural form work and waste molds.

Contractors may obtain their services, again without cost, as advisors on the construction project during the period of form erection and concreting operations.

Many architects, especially in the eastern and mid-western sections of the country, have long recognized the value and economy of monolithic concrete as an architectural material, but have hesitated to employ this medium because contracting organizations and construction superintendents in their particular localities have lacked experience in this type of construction.

The commendable action now taken by the Portland Cement Association should result in a far more extensive use of monolithic concrete for the exterior parts of buildings. Architects and contractors having such work in hand should not fail to apply for this very practical service.

Higher Stress in Reinforcing Steel

In an article in this issue of CONCRETE, Dr. Fritz von Emperger, the noted Austrian engineer, brings some heavy artillery to the aid of engineers who, for many years, have fought for the use of higher allowable working stresses in reinforcing steel of high elastic limit.

The new British code of practice, to which the author refers, permits a tensional stress (in bending) of 18,000 lb. per sq. in. in mild steel with a yield-point below 44,000 lb. per sq. in.; 20,000 lb. in mild steel having a yield-point of 44,000 lb. or more; and 25,000 lb. in high-yield-point steel, though not exceeding 0.45 of the actual yield-point stress in any given steel.

In this country the opposition to higher working stresses in high-elastic-limit steel reinforcement has been based almost entirely on the supposition that the greater elongation of the steel, because of the higher stress, would open excessively wide cracks in the adjacent concrete. These cracks, it has been argued, would expose the steel and lead to its corrosion. No tests had been made, however, to determine the approximate stress where the danger of corrosion begins. In consequence, opposition to the higher working stresses in high-elastic-limit steel has been founded only on opinion, and this opinion, in turn, was guided largely by the desire to "be on the safe side"—a desire that is inspired by timidity rather than by engineering judgment.

The engineering profession should be grateful to Dr. Fritz von Emperger for giving us a definite basis for judging this question.

PROGRESS—In a Page

◀ Current activities in research, in matters pertaining to concrete and cement, as being carried on or completed by various organized groups. ▶

Testing Apparatus Exhibit

THE 1935 exhibit of testing apparatus and related equipment offers the producers and distributors of testing equipment, laboratory supplies, measuring instruments and related apparatus a splendid opportunity to contact outstanding engineers and other executives who are directly interested in the production and use of engineering materials.

The 1935 exhibit is the third to be sponsored by the A. S. T. M., two previous successful exhibits having been held in Chicago in 1931 and 1933. It will be held concurrently with the thirty-eighth annual meeting of the society, June 24 through 28. The Book-Cadillac Hotel, with its fine meeting facilities, also has an excellent layout for the A. S. T. M. exhibit. In the Grand Ballroom there are available complete exhibition facilities, and the room is fully air-conditioned.

Inquiries for space should, of course, be addressed to the American Society for Testing Material, 260 So. Broad St., Philadelphia.

Life of Rural Highways

DURING the last annual meeting of the Highway Research Board, in Washington, D. C., Dean Anson Marston announced the immediate start of active work on a co-operative project of the U. S. Bureau of Public Roads and the Iowa Engineering Experiment Station for the collection, study and publication of extensive data on the actual service lives of rural highway surfaces of various types in several states. The committee on highway transportation economics of the Highway Research Board is participating in planning and guiding the work. Co-operation is sought from highway commissions and highway officials and engineers in the several states.

Aggregates Specifications

UNDER date of April 3, 1935, the Federal Specifications Board of the Treasury Department Procurement Division, Washington, D. C., has approved an amendment to Specifications for Aggregates for Portland Cement Concrete (SS-A 281).

Significance of Tests

OUTSTANDING standardization work has been accomplished by the American Society for Testing Materials in the field of concrete and concrete aggregates, through its Committee C-9 on Concrete and Concrete Aggregates, which includes in its personnel men who have pioneered and who are leading the way in many developments in this field. This committee has prepared the report on Significance of Tests of Concrete and Concrete Aggregates, mentioned briefly on this page in the April issue.

For some time there has been evident the need for an effectual summation of the significance of concrete and aggregate tests, their relative importance and how adequately they give a true value of concrete properties. In this report, Committee C-9 takes an important forward step to achieve these purposes.

After the preparation of particular sections by recognized authorities on the respective subjects, the material was sent to the entire C-9 membership for critical review. Comments went to the authors for study, and finally C-9 balloted on the acceptance of the report. Thus it represents the consensus of representatives of the many producing and consuming interests on the committee. This procedure has resulted in a report of outstanding interest.

Following an introduction by Prof. Arthur N. Talbot, ten sections are devoted to concrete tests and six to aggregates. A discussion of the number of specimens or tests required for a reasonable accuracy of the average completes the report. A list of the subjects covered, together with the authors, follows:

Compressive Strength of Concrete—Inge Lyse, research associate professor of engineering materials, Lehigh University.

Tensile and Flexural Strengths of Concrete—A. T. Goldbeck, director, bureau of engineering, National Crushed Stone Assn.

Shearing and Torsional Strengths of Concrete—A. T. Goldbeck.

Elastic Properties of Concrete—F. E. Richart, research professor of engineering materials, University of Illinois.

Durability of Concrete—C. H. Scholer, professor of applied mechanics, Kansas State College of Agriculture and Applied Science.

Abrasion of Concrete—C. H. Scholer.

Workability of Concrete—J. C. Pearson, di-

rector of research, Lehigh Portland Cement Co.

Volume Changes of Concrete—R. E. Davis and J. W. Kelly, professor of civil engineering, in charge of engineering materials laboratory, and research engineer, engineering materials laboratory, respectively, University of California.

Cement Content of Hardened Concrete—H. F. Kriege, in charge, France Stone Co. Laboratories.

Uniformity of Concrete—R. L. Bertin, chief engineer, White Construction Co., Inc.

Gradation, Specific Gravity, Unit Weight and Voids of Aggregates—Fred Hubbard, consulting engineer, The Standard Slag Co.

Soundness of Aggregates—Stanton Walker, director, engineering and research division, National Sand and Gravel Assn.

Abrasion of Aggregates—H. F. Clemmer, engineer of materials, District of Columbia.

Free Moisture and Absorption of Aggregates—Bert Myers, engineer of materials and tests, Iowa State Highway Commission.

Deleterious Substances—F. C. Lang, professor, highway engineering, University of Minnesota; and engineer of tests, inspection and research, Minnesota State Department of Highways.

Mortar Strength Tests of Fine Aggregates—F. H. Jackson, senior engineer of tests, U. S. Bureau of Public Roads.

The Numbers of Specimens or Tests of Concrete and Concrete Aggregates Required for Reasonable Accuracy of the Average—R. W. Crum, director, Highway Research Board.

Prices: \$1.25 per copy; to A. S. T. M. members, \$1.00. Special prices on orders for ten or more copies. The report is bound in heavy paper and contains 125 pages.

Direct Addition of Calcium Chloride

TESTS conducted by the highway department of the District of Columbia show that complete dissolution of the calcium chloride will take place within the mixing time and that entirely satisfactory results will be obtained by placing the dry flake calcium chloride directly in with the materials in the skip, as well as if the solution of calcium chloride were added with the mixing water or directly into the drum of the mixer.

This method is of particular importance for use on small projects where it is not practicable to require equipment designed for the mechanical control of the incorporation of the specified amount of calcium chloride.

Architectural Concrete



ARTHUR BROWN, JR., *Architect*

Coit Memorial Tower, recently erected on Telegraph Hill, in San Francisco, by the San Francisco Board of Park Commissioners to comply with the bequest of Mrs. Lillie Hitchcock Coit, is built entirely of monolithic concrete. The highly attractive surface finish was obtained through the use of plywood forms, for the fluting of the tower shaft as well as the broad surfaces at the base. The height of the tower is 172 feet.

The architect of this outstanding example of architectural concrete work is Arthur Brown, Jr., of San Francisco. The contractors were Young & Horst-meyer.

25-Ton Precast Slabs in Seattle's Sea Wall

**Huge Reinforced Concrete Slabs Transported to Site
in Scows—Form Buffer to Pounding of Sea**

By R. C. HILL
Seattle, Washington

ENGINEERING skill was sorely taxed to solve the problem of how to protect the fill on Seattle's waterfront from the never-ceasing ravages of the restless ocean. By a combination of wood and steel sheet piling and huge precast concrete slabs the engineers have evolved a type of sea wall that is interesting and unique.

Several formidable physical difficulties had to be overcome. Much of the 6,800 ft. along the harbor front had been filled with sawdust and other unstable materials, so that in places it was necessary to go down 100 ft. before reaching solid ground. Then the proposed work involved an extensive fill behind the sea wall, totaling 245,000 cu. yd. of sand and gravel. How to build a permanent wall that would keep out the sea and hold in the fill along the avenue was the question that required an answer.

To reach a stable bottom, long Douglas fir timber piles were driven far under water. Also, under water, interlocking steel sheet piling has been used, while above the water line the face of the sea wall is formed by enormous precast concrete slabs which not only are units of a permanent construction, but at the same time present a pleasing appearance. The various materials are so

securely tied in and interlocked that they will form a stable avenue, secure from the attacks of the sea.

The huge precast concrete units are made at a special shop, established for the purpose. Similarly, all the heavy timbers placed in the work are shaped, dapped, grooved and bored, so that upon arrival on the ground they are set and bolted without delay.

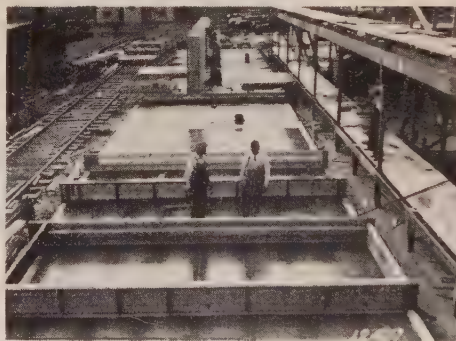
The type of concrete slab adopted is unique, not only because of its size and weight, but because of its unusual shape. Each block measures 8 ft. wide, 20 ft. long, and 18 in. in thickness, while the projecting arms are 9 ft. long. The weight of each slab is 25 tons.

The slabs are placed on top of the

sunken sheet steel piling, but the weight is supported by the timbers inshore, each slab being locked into the timber structure by means of the prongs of the block. In this manner a wall of maximum strength is provided, back of which is the sand and gravel fill. On top of this fill the pavement and railroad tracks will be laid.

Special forms of steel and timber were constructed at the concrete plant where the slabs are cast. The slabs are strongly reinforced with steel bars. When completed, they are lifted by a derrick to scows which deliver them to the job. There they are lifted by a derrick scow and each slab is carefully lowered into its permanent position. As many as nine blocks a day have been placed by the working crews.

The Seattle waterfront job is a \$1,400,000 project, begun early in 1934 and planned for completion in 1936. So accurately had the engineers planned the construction schedule in advance that the work is proceeding according to schedule. Traffic is suffering the minimum of interruption in the meantime, as the project is being built in sections.



(Left) Casting 25-ton precast reinforced concrete slabs for Seattle's new sea wall. (Right) Lifting the slabs into place

Associated General Contractors Prepare for Construction Activity

**Governing and Advisory Boards Meet in Washington to Lay Plans
for Handling of Contracts Under Emergency Relief Act**

ANTICIPATING a summer of the most intensive construction activity in five years, the governing and advisory boards of the Associated General Contractors of America will hold their annual spring meeting in Washington, D. C., on May 2 and 3, to lay plans for the expeditious handling of their industry's part in the President's \$4,380,000,000 work relief program.

Representative contractors from the building, highway and heavy construc-

tion and railroad divisions of the industry will participate in the meeting, which will give detailed attention to the question of facilitating contract methods in each of the various construction fields included in the Act.

Contractors believe that a major portion of the construction phases of the program will be executed under contract, in view of the provision in the measure that full advantage shall be taken of the facilities of private enter-

prise in the carrying out of the work. The board will exert every effort to see that this is done.

E. J. Harding, managing director of the contractors' association, in announcing the call for the governing and advisory boards meeting, expressed the belief that under the impetus of the work relief measure the coming summer will witness a banner season in all lines of construction. He pointed out that the fund, as earmarked in the bill, will provide, in itself, a well-rounded volume of building, highway and heavy construction projects. Harding also was optimistic as to the prospects of revival in private residential construction, and declared that the board would give special attention to this field.

Ready-Mixed Concrete— Its Present and Future

By H. F. THOMSON

President, National Ready-Mixed Concrete Association*

AN important operator in an Eastern city, who has been in the ready-mixed concrete field a number of years, recently reported that his company's business reached the bottom in 1933, and that their volume of ready-mixed concrete in 1934 amounted to 85 per cent of their best year. Probably few of us were so fortunate last year, but we can all be hopeful that the many activities which have been started to stimulate the durable goods industries will be decidedly helpful to the ready-mixed concrete industry, and that during 1935 we shall find opportunities for furnishing steadily increasing quantities of our material.

Pioneering Stage Is Ended

The ready-mixed concrete industry has turned at least one important corner during the last two years. Our operation in delivering concrete pre-mixed and ready-to-place was previously considered by constructors as largely experimental, and every producer was fighting to have his operation accepted by the local building industry. Almost without our realization, a decided change in attitude has taken place. Ready-mixed concrete can now be considered as an accepted method on all types of construction. It is no longer a question of whether ready-mixed concrete could be used, but the big question on each individual job now is whether ready-mixed concrete is the economical operation for that job. Thus we may think of the pioneering stage as ended. We are now in a strictly competitive stage where our customers and prospects can accurately analyze their relative costs and not penalize ready-mixed concrete because of an assumed hazard in using a new method of servicing concrete construction.

At the same time there has been established the realization that ready-mixed concrete, when properly mixed, delivered, and placed, represents a better quality of concrete than is readily obtainable by usual job-mixing

methods. This reputation for better quality is a valuable asset. Each of us should do his utmost to develop this reputation.

Specifications Adopted

At the Detroit convention two years ago we discussed at length the features of a purchase specification for ready-mixed concrete. This activity, which was initiated by our association and was later taken up by the American Society for Testing Materials, has resulted in the A.S.T.M. adopting a standard specification for ready-mixed concrete. This specification stamps the ready-mixed concrete operation with the approval of a very important technical body. It offers every operator ammunition to use in extending the use of this material in his community. As the volume of construction increases there will be growing opportunities for architects and engineers to refer to this specification in writing up their requirements for buildings. Because of the newness of ready-mixed concrete, our type of service was definitely not acceptable on construction for a number of the government departments until fairly recently. Today, as far as I know, ready-mixed concrete is acceptable on every type of government construction, with the possible exception of one department which has little construction now in prospect.

The National Ready-Mixed Concrete Association has also conducted extensive correspondence with many who have indicated an interest in ready-mixed concrete and its problems. The distribution of papers and other information presented at our conventions has led to a wider knowledge of the possibilities of this type of concrete service. These matters have been of value, either directly or indirectly, to many operators, frequently without the knowledge of the operator himself. I firmly believe the association merits the support, both morally and financially, of everyone who has invested in the ready-mixed concrete field. The opinion is widely accepted that every progressive industry needs an aggressive trade association now more than ever before.

Definite Benefits from Code

In thinking of the Ready-Mixed Concrete Code, we naturally feel that we have all been called upon to pay assessments toward maintaining the Code Authority, and wonder what we have received in return. In the first place, I do not think we should look upon the results under any single code alone; rather, the whole code activity has been the expression of a nation-wide effort to put industry in the position of self-government, and we feel that by and large a great many irregular practices have been eliminated. In the second place, the Ready-Mixed Concrete Code has been of value in establishing an opportunity for independent handling of the problems of ready-mixed concrete in each community. And in the third place, we believe that our code and the codes of related industries have given us firmer market prices than we would have had, otherwise, with the very limited volume of construction business in most communities during the last year. There has been no exploitation through unduly high prices. Beyond our intention to establish reasonable prices, our competition always exercises a hair-trigger control of the prices for our material.

Technical Development Must Continue

And as we think of the future, we as an industry can not afford to forget our technical development. Continued effort toward further improvement in our operation and our service will always be needed. As one means directed toward such collective progress the National Ready-Mixed Concrete Association purposes to sponsor a series of studies of the problems which face ready-mixed concrete operators. These studies, or investigations, will be under the supervision of a small but representative technical problems committee, under the chairmanship of R. B. Young. As in the development of our standard specifications, Mr. Young has again consented to give the ready-mixed industry the benefit of his exceptionally broad designing, operating, and commercial experience.

It is also expected that we can continue to strengthen our pleasant relations with other organizations, both technical and commercial, who are interested, like ourselves, in the theme of "better concrete." The accuracy and the control represented by a well-handled "ready-mixed" operation has

*Abstract of paper presented before the fifth annual meeting of the National Ready-Mixed Concrete Association, at Chicago, Ill., January 31, 1935.

called attention to many features of concreting which were heretofore unrecognized. Who ever heard of an overrun of 5 per cent or even 10 per cent in the aggregates of a given job being the subject of criticism? Such variations have been considered a necessary hazard. But let the yield of "ready-mix" from a commercial plant under-run by only 2 or 3 per cent and an investigation is immediately necessary.

Also, in the matter of strength, the "ready-mix" operation can now offer to the designer and the constructor a concrete of any desired strength, with full assurance that material of the proper strength will be furnished. Also, some of the surprisingly beneficial results from an elapse of half or three-quarters of an hour between mixing and placing have shown the need for an extended investigation of what happens in concrete during the first hour after the water is added. This calls for laboratory studies which our industry is not in position to undertake; but as the problem is that of all concrete, let us hope that other organizations which are also interested in learning the un-

derlying facts will initiate a laboratory program in which we can co-operate by contributing our practical experience.

Question of Merchandising

Another problem which has faced every operator is that of merchandising. Although we have not yet undertaken the task, it has been suggested that the association collect information on the results obtained with different methods of marketing ready-mixed concrete, such as offering to furnish strength concrete, or a stated cement content, or only arbitrary volume proportions; or selling direct to the user, or marketing through one or more jobbers.

Also in looking forward, I think each operator should keep in view the fundamental status of the ready-mixed concrete operation. Our operation is a unique combination of the features of manufacturing, jobbing, transportation, and service. We produce a perishable product, made-to-order, and delivered exactly at the time and rate named by our customer. But the jobbing, transportation, and service functions are

worthless unless we maintain the quality of the product. Hence the manufacture of the concrete, whether in a central-mixing plant or in truck-mixers, or by other methods, is our underlying function, and the others are accessory. Ours is a specialty manufacturing process, which requires first the point of view of making a quality product, and second, the facilities for properly distributing and servicing.

Some instances have occurred where a ready-mixed concrete operation has been undertaken without full realization of the requirements of our unusual type of business. Such instances have sometimes resulted unfortunately, both for this new operator and for the previously established ready-mixed concrete production in the locality. It is with hope of warning against such unfortunate experiences that I have mentioned some of the exacting requirements in the ready-mixed field.

As we review the state of the ready-mixed concrete industry as a whole, we arrive at the conclusion that there are distinctly promising opportunities in our field.

C. R. S. I. Meets

THE eleventh annual meeting of the Concrete Reinforcing Steel Institute was held on April 29, 30 and May 1 at the Homestead Hotel, Hot Springs, Virginia.

The following subjects, all vitally affecting American industries and the reinforcing industry in particular, were reviewed:

The General Code Movement and the NRA
The Future of the National Industrial Recovery Act

Does This Industry Want and Need a Code?
The Observer's Viewpoint of Codes

How Can This Code Be Enforced More Efficiently?

Promotional Developments in the Reinforcing Industry: (Including Technical Progress in Concrete.)

R. W. Johnson is secretary of this association and of the Code Authority for the Reinforcing Materials Fabricating Industry, located at 201 North Wells Street, Chicago.

Last Concrete in Main Boulder Dam

The main structure of Boulder Dam was completed on February 21, when the last 20-ton bucket of concrete was added to the 3,300,000 tons which had gone before.

On June 6, 1933, when the first concrete was placed in the foundation, it was estimated that 2½ years would be required to complete the concreting, but the job has been finished a year ahead of time.

A roadway, parapet and architectural features will be built on top of the dam and the power house will be completely in July. Two of the seventeen generators are expected to be in operation in January, 1936, and two more the following March. Under this plan power can be furnished to Los Angeles in June, 1936.—*New York Times*.

Free Service of Superintendents on Architectural Service

THE Portland Cement Association has obtained the services of two construction superintendents from the West Coast. Each of these men has had at least 15 years experience on architectural concrete jobs. They have been employed in order that they may assist architects, engineers and contractors on the design and construction of this type of work.

The services of these superintendents may be obtained free by making application to the Structural and Technical Bureau of the Portland Cement Association. One of these superintendents may be sent to an architect's office to assist him with details, and when the job goes into construction, he may be loaned to the contractor as an advisor on construction problems.

PERSONAL

The Portland Cement Association, Highways and Municipal Bureau, announces the appointment of four regional highway engineers.

Leon F. Andrews has been appointed for the Northeastern section of the United States.

William E. Barker, Southeastern section.

Ezra C. Wenger for Illinois, Michigan, Indiana, Ohio, West Virginia and Kentucky.

A. A. Anderson for Southwestern, Pacific and adjoining states.

The Concrete Products Manufacturer

Code Administration

+ + +

News of the Industry

ON the page following this, concrete products manufacturers will find a new feature headed *The Clearing House*, appearing for the first time.

It is expected that this will be made a monthly feature of CONCRETE; and as the heading implies, it is to be, in fact, a clearing house of ideas contributed by members and friends of the concrete products industry.

What, for instance, do you think of the concrete masonry code? What are its weak points and its strong points, and what changes would you suggest? What are some of your local problems arising from price-cutting and chiseling? Has your own local group been successful in handling such problems?

Your ideas on these and similar problems and questions will be of interest to the whole industry. Through a full and free discussion in the pages of CONCRETE, the answers to many of the problems will be found.

So let us hear from you. Your name will not be printed except with your specific consent; but your expressed opinion will help to solve the difficulties faced by your industry.—The Editor.

From the Code Authority Official Communications

Monthly News Letter

By H. W. BUSH

Secretary-Treasurer, The Code Authority,
Concrete Masonry Industry*

BELIEVING that it will be of considerable interest to the majority of the members of the industry, a few of the pertinent provisions included in the new bill to extend N.R.A. for two years, are here given, as follows:

- (1) A definition as to what constitutes interstate commerce, which seems to be so broad as to cover practically everything. It will be remembered that this has been the principal reason for adverse decisions in the courts.
- (2) The re-enactment of Section 7 (a), which guarantees the right of collective bargaining.
- (3) A provision that codes must not sanction, promote or maintain monopolies, eliminate or oppress small industries.
- (4) Devices for controlling prices, production or distribution may be ordered when found necessary to protect small industries.
- (5) Limited codes may be imposed.
- (6) With the consent of industries, the President shall have the right to combine groups of small industries under general codes.
- (7) The extension of all present codes for a period of ninety days after the present law expires on June 16, 1935.
- (8) Under penalties, the prison sentence has been eliminated, but a fine for code violations has been provided for.

According to information recently received, seven states have adopted uniform state recovery acts, which eliminates the question of jurisdiction over interstate and intra-state business, as all national codes under these state enabling acts become state codes as well. The seven states which have adopted the act are Idaho, Indiana, New Mexico, Oregon, Washington, West Virginia and Wyoming. Twenty-three other states have introduced similar measures in the legislature. Undoubtedly, compliance will be much more effective as additional states fall into line.

It is interesting to note that several industries, within the past few weeks, have adopted resolutions urging that the Recovery Act be continued beyond its expiration date, for at least a period of two years. A resolution adopted by the construction code authority, declared that the National Industrial Recovery Act has been an important feature in its progress toward recovery. At a meeting of the construction code authority, it was emphasized that active and energetic enforcement was a necessary requirement to proper administration by code authorities.

From one of the cities in the state

of Missouri, comes a story with a decided moral, and recognition of the facts should be taken into consideration by every member of the industry who would attempt to compete on projects financed wholly or in part with government funds. An appropriation of \$4,800,000,000 is now in the hands of the President of the United States, a good part of which will be used for projects which require the material manufactured by this industry's members. A project financed with PWA funds required 15,000 8-in. concrete units. In the actual words of the low bidder, he says in part as follows: "I have no use for the code and intend to run my own business in my own way." With the assistance of Dan F. Servey, a member of our code authority, we were successful in having the award made to a member of our industry in that territory, who was in full compliance with the code and at a price considerably in excess of the low bid. A letter from the successful bidder states in part as follows: "It was only through the cooperation of Mr. Servey and the code authority that we succeeded in selling the blocks for the PWA project. Many thanks to all the members of code authority and best wishes for its success." The moral: Get out of the ten per cent class and join the ninety percenters.

Government stimulus will provide for a steady flow of industry products from manufacturer to consumer. Unless you are in full compliance with your industry's code, you are excluded

*211 Edgemont Place, Teaneck, N. J.

from bidding on this type of work. If you have any doubts as to your compliance, communicate with the secretary.

The by-laws of this industry's code authority require the election of a new code authority on or before May 16, 1935. In view of the fact that extension of the Act is still being debated and that its scope and functions have not been made clear, we have recommended to the administration the continuance of the present members of the code authority for a period of ninety days from May 16, 1935.

Representative Groups — We have heard from several local groups throughout the country that they are endeavoring to prepare the necessary information which will enable them to be approved by the code authority and the administration, in order to administer the provisions of the code in their respective territories. It is our suggestion that other groups immediately organize along the lines that have recently been given considerable publicity.* More effective administration and compliance can be obtained by local groups.

Costs — Competition and fear of it can be relied upon to keep prices down where they will be profitable only to the most efficient manufacturer. From my own experience, and that of countless others, undoubtedly, N.R.A. still

*See CONCRETE, April, 1935, pages 19 and 20.

needs experts, committees and rules to prevent selling below cost and to drive home the fact that cost includes all of the connected items of expense in addition to material and labor. Although current indications appear to point to the elimination of most price-control provisions in all N.R.A. codes, it is predicted that standard cost systems will continue to develop and of necessity become a part of industrial education, if not mandatory provisions of codes.

An aspect of the question of selling below cost, which is larger than the fate of the business man or employer, is that of fair wages and continued employment to the working man. These are impossible of attainment unless somewhere there rests the power of commodity price regulation, or the elimination of selling below cost. Nobody will be more to blame than the administration itself, if compliance becomes increasingly hard to effect.

N.R.A. has already suspended, without notice or hearing, by its inaction, a provision of our code which states that no member of the industry shall sell any commodities below his own individual cost, and that cost shall be determined in accordance with the principles enumerated in a standard cost system, which shall be formulated by the code authority. Since the inaction of the government in connection with this vital provision would indicate its abandonment, disorganization is bound to result and it is feared that the

racketeering elements will again attempt to bludgeon and chisel their way to control.

There appears to be one solution. The N.R.A. should give us a cost system. It can not well permit this industry to relapse into chaos or allow the influence of such negligence to demoralize the ninety per cent who believe in the principles of the N.R.A. The prohibition of selling below individual cost is too complicated to have any meaning, unless qualified by a cost-finding formula.

It was never the intention of this industry to make the use of any cost system mandatory upon members of the industry or to change in any particular, methods of book-keeping already in operation by the various plants. Its use would be required only in the case of a complaint purporting to show that any industry member was selling below individual cost. I quote from an issue of "Box-Craft" as follows: "The prevention of sales below a manufacturer's own cost is healthy industrial food. And it is not only healthy for the Blue Eagle, but for labor, investors and consumers as well. The guarantee of a return of cost means permanency for labor, safety for investors, credit possibilities for banks, assurance of non-employment provisions and sufficient tax collections to pay for the tremendous cost of national expenditures made during the past two years, and perhaps reduce the national debt as well."

The Clearing House

Letters from Readers

Readers having constructive suggestions to offer for the good of the concrete products industry are invited to send them to us, for publication in this section. Names will not be used unless the writer has given his specific consent.

It should be understood, of course, that the items appearing under this heading are not official expressions, nor do they necessarily agree with our views. They express, primarily, the views of the persons who write them.—The Editor.

How to Organize Local Code Committees

Enforcement of the concrete masonry code is being decentralized and is being placed into the hands of local groups

as rapidly as these groups are becoming organized.

Detailed instructions on the various steps to be taken in organizing local groups for local administration of the code will be found on pages 19 and 20 of the April issue of CONCRETE.

REPRINTS of these instructions will be supplied by CONCRETE at 5 cents each in lots of five or more. Get five or ten of these reprints for the use of your own local groups. They will help you to get organized without a hitch.

Local Committees Can Enforce the Code

Editor, CONCRETE: Congratulations on your new section for *The Concrete Products Manufacturer*, and thanks for

the *Monthly News Letter*. That is what we need to keep us informed of what is going on in our industry.

Let me add just a word about code enforcement. In our city and its surrounding trade area we have for some time had in operation a local committee that has operated along the lines outlined by the code secretary on page 20 of your April issue. In spite of our lack of official standing, we have been able to prevent many code violations, simply by keeping our eyes and ears open and following through with any corrective measures that we started. In some cases we found that claims of unfairness were unfounded, but in other cases they were substantiated.

In my opinion the code can be enforced wherever local groups accept the responsibility. In localities where every one sits back and kicks, expecting "George" to do it, code violations will prevail.

We are now taking the necessary

steps to gain official status, as outlined by Mr. Bush in your April issue.—J. B., Pennsylvania.

Price-Fixing Is Out

Editor, CONCRETE: Judging from my correspondence and conversations with other products manufacturers, many of them are laboring under the delusion that the concrete masonry code permits price-fixing. I believe you should make it known, through the pages of CONCRETE, that price-fixing is not permitted in our code. Out of all the codes written, only nine authorized some form of price-fixing, but the concrete ma-

sonry code was not one of them.

The actual filing of prices is required by the code; and this is important. If your competitor has not filed his price lists, with the secretary of our national code authority, he is violating the law. Any manufacturer is also violating the law—and violating it seriously—if he sells below the prices he has filed.

A few progressive manufacturers in any section can accomplish much toward the establishment of fair prices if they will take hold of the problem in an aggressive manner. First, check up on all products manufacturers in the section, and find out if they have filed

their price lists. Then find out if they have sold below their filed prices. Next, get into touch with the state administrator of the NRA. In the meantime, start organizing an official local group for code enforcement, in accordance with the procedure outlined on pages 19 and 20 of the April issue of CONCRETE.

With all this going on, you may depend on it that the 10 per cent of trouble-makers will think twice before repeating their violations of the code.

The Cement Products Co., 715 East River St., Davenport, Iowa.

AUSTIN CRABBS,
Member of Code Authority, Concrete Masonry Industry.

Code Authorities

FOLLOWING are the addresses of the code authorities of industries and branches of industries related or of interest to the concrete construction industry. When writing to a code authority, include the words "code authority" in the address, thus: Code Authority, Construction Industry, National Press Building, Washington, D. C.

Builders' Supplies Trade, Room 1907—Investment Bldg., Pittsburgh, Penna.

Cement-Gun Contractors Industry, 651 Munsey Bldg., Washington, D. C.

Concrete Burial Vault Industry (Chairman of Code Committee is L. A. Chick, care of Blairsville Concrete Products Co., 100 North East Lane, Blairsville, Penna.)

Concrete Masonry Industry, 211 Edgemont Place, Teaneck, N. J.

Concrete Mixer Manufacturing Industry, 221 W. Madison St., Chicago, Ill.

Concrete Pipe Industry, 33 W. Grand Ave., Chicago, Ill.

Construction Industry, National Press Bldg., Washington, D. C.

Construction Machinery Distributors Trade, 207 W. Pearl St., New York, N. Y.

Crushed Stone, Sand and Gravel, and Slag Industry, Munsey Bldg., Washington, D. C.

General Contractors' Industry, 222 Munsey Bldg., Washington, D. C.

Portland Cement Industry, 111 W. Washington St., Chicago, Ill.

Ready-Mixed Concrete Industry, 951 Munsey Bldg., Washington, D. C.

Reinforcing Materials Fabricating Industry, 201 North Wells St., Chicago, Ill.

Steel Joist Industry, 201 N. Wells St., Chicago, Ill.

Waterproofing, Dampproofing, Caulking Compounds and Concrete Floor Treatments Industry, 11 West 42nd St., New York, N. Y.

Burial Vault Manufacturers Have Big Meeting

Cleveland Convention Program Packed Full of Ideas—Officers Elected

THE annual meeting of the National Concrete Burial Vault Association, held at the Statler Hotel, Cleveland, on April 24 and 25, drew a large attendance from the manufacturers representing this robust young industry.

The program—printed in full on page 10 of the April issue of CONCRETE—was packed full of good ideas for the improvement of merchandising methods as well as manufacturing processes.

Talks were given on the subject of advertising, and sales talks by several members of the association brought light into some dark places in this branch of the industry. Manufacturing

processes were shown in motion pictures.

The annual dinner, held on the evening of April 24, was well attended and the program of entertainment provided an excellent diversion from the hard grind of the convention.

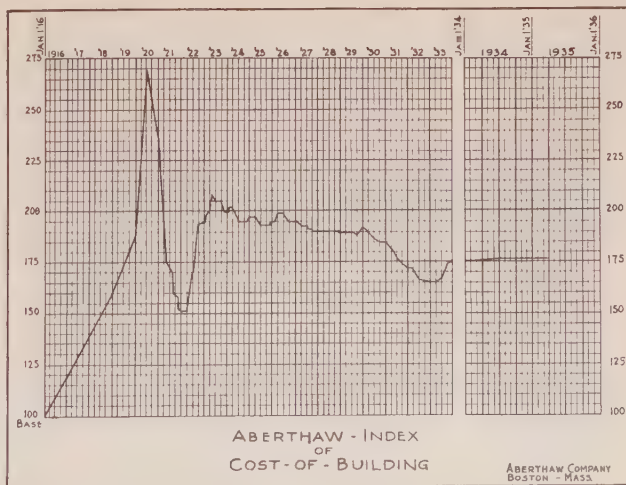
Newly elected officers for the coming year include George Painter, of Philadelphia, as president; L. A. Chick, of Blairsville, Penna., as vice-president; and J. H. Stuart, Bremen, Ohio, re-elected as secretary. New members of the board include George Painter (the new president) and Harold Coburn, of Whitman, Mass.

Aberthaw Index of Building Cost

CONSTRUCTION costs remain stabilized, according to the Aberthaw index of the cost of industrial building, for the quarter ending March 31, 1935. The index value continues to stand at 176.5, at the same level as for the three preceding quarters. Little change has occurred, in fact, since the last quarter of 1933.

This value corresponds to a unit cost of \$1.85 per sq. ft. of floor area for the 7-story reinforced concrete industrial

building, from which quantities are taken in computing the index.



Ten Selling Points About Precast Joists for Residence Floors

Products Manufacturer Tells of Success in Marketing
This Type of Floor—Main Effort Directed at Architects

By C. EVERETT BURBANK

Bedford Hills Concrete Products Co., Bedford Hills, N. Y.

THE great majority of concrete floors in modern home construction will be of the precast concrete joist type. For about 2½ years we have been working on the precast joist method and for a somewhat longer time we have sold ready-mixed concrete for poured-in-place floor systems. Thus I have been in a position to see both systems in operation. The poured-in-place slab type, pan type, and other systems not using precast joists will, without a doubt, be used to some extent by a few contractors and builders. These men in most cases have become thoroughly familiar with some particular system which may, to the average contractor, seem too complicated to tackle. These systems all have merit in other types of buildings. Probably 95 per cent of the contractors, builders and architects consider these poured-in-place systems either too complicated or too costly for general use in modern home construction. This brings us back to the precast joist system to work with on the 95 per cent of home floors that should be built of concrete.

Cost Comparisons Are Favorable

First, let us take up the matter of cost. With an article as new to the public as precast concrete joists are, cost

Condensed from paper presented at the annual meeting of the National Concrete Masonry Association, held at New York, Feb. 18 and 19, 1935.

must in most cases be spoken of in comparative terms. We have found it to compare favorably with all other fireproof floors and in most cases a substantial saving can be shown. When compared with wood joist construction, we have found that in a few cases they are equal. However, in general, the concrete joist first floor will add from ½ per cent to 2 per cent to the cost of the house, and for second floor work, slightly more. Perhaps the greatest sales resistance we have incurred has come from contractors who, in submitting figures on precast joist work, make them so high as to add as much as 5 per cent to the cost of the same house with wood joists. These figures have been from contractors who couldn't be bothered long enough to learn the simplicity of the precast joist method. Our experience has been that those who have used precast joists or have thoroughly investigated them can be depended on to give a figure that is very attractive.

Another item which ties in closely with cost is the matter of financing. We recently made a survey of a number of bankers in our locality and found that without exception they were in favor of the fireproof first floor as good security for a loan.

Our first concrete joist job went into an architect's own home. He made a practice of using fireproof floors and was thoroughly sold on them. Since

that first job, this architect, within a year's time, has had four more residence jobs, and in all cases he has used the precast joists. Many of his plans have started out elaborately, and other things have had to be cut, but the concrete joist floor always stays.

Favorable Points about Precast Joist Floors

Increased Salability. We recently interviewed a number of real estate men in our territory. If any products manufacturer is thinking of going into the joist business, I would recommend that he see his own real estate men about the salability of a house with a concrete first floor. We found that in all cases where the real estate men had had experience with fireproof first floors they were in favor of them. They felt that a house with a fireproof first floor was easily worth 5 per cent more than the same house with a wood joist floor. Our work with the speculative builder is just starting. We have at the present time one of the largest builders of the better speculative houses in Westchester County signed up for precast joists for his next two houses. He is thoroughly convinced that it will mean quicker sales at greater profits.

Fire Safety. Concrete floors offer the greatest protective feature against fires of internal origin that can be built into a home. They offer an adequate fire-stop for basement fires in the home. Even though they are not given recognition as yet by the Fire Underwriters



(Left) Precast reinforced concrete floor joists are readily handled by two men. (Right) Form boards and steel reinforcement for cast-in-place concrete slab are supported by the concrete joists, no shoring being needed

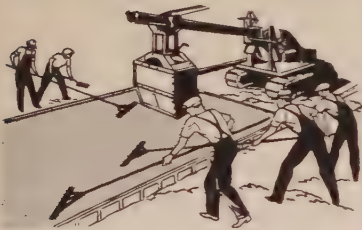
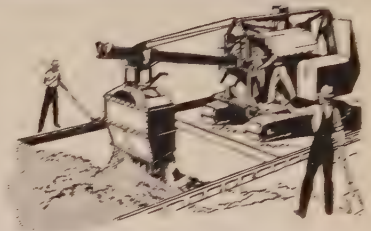
CALCIUM CHLORIDE

FOR MODERN CONCRETE CURING

To KEEP pace with the progressive trend of concrete paving and building construction in general, the important detail of curing must likewise follow the most modern and efficient

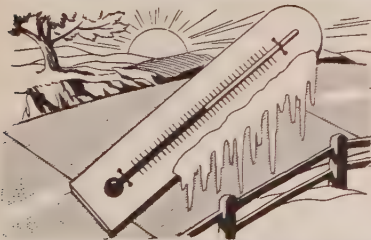
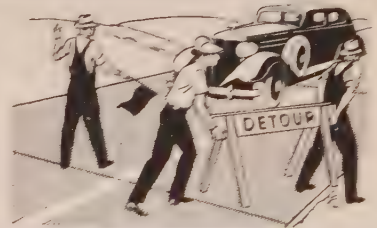
method. The ideal method, as confirmed by researches of the National Bureau of Standards, Ohio State University and other authorities, is through CALCIUM CHLORIDE used integrally.

CONTROLLED MOISTURE CONTENT . . . Calcium Chloride in the mix controls the moisture content of the concrete—thereby materially minimizing detrimental volume changes and hair checking.



INCREASED WORKABILITY . . . By enabling a reduction of $\frac{1}{2}$ gallon of water content per sack of cement, Calcium Chloride maintains a workability of the concrete equal to that of plain cement concrete.

GREATER DENSITY AND DURABILITY . . . Calcium Chloride insures the development of high-strength concrete at all temperatures; and, due to its accelerated curing properties, enables earlier removal of forms and shortens the opening time for traffic by as much as one-half.



ALL-WEATHER CONCRETING . . . Due to Calcium Chloride's value for accelerating the curing, concreting is made a year-round rather than a seasonal industry.

By effecting the advantages mentioned above, Calcium Chloride curing benefits: (1) The public through earlier use of the highways. (2) The taxpayer through a better return on his investment. (3) The contractor from savings through earlier job completion. . . . While public officials win praise for their efficient administration of highway improvements.

With road building and construction taking on a new impetus under the recently enacted Work Relief measure,

full information on Calcium Chloride curing should be in every hand directing concreting work. Write for further literature. Address any of the following members of the

CALCIUM CHLORIDE ASSOCIATION

MICHIGAN ALKALI COMPANY . . . 60 E. 42nd St., New York City
SOLVAY SALES CORPORATION . . . 40 Rector St., New York City
THE DOW CHEMICAL COMPANY Midland, Michigan
THE COLUMBIA ALKALI CORPORATION Barborton, Ohio

You can buy with confidence from CONCRETE.

where used only in the first floor, men from several departments of the National and New York Boards of Fire Underwriters, as well as the Suburban Fire Exchange, expressed personal opinions that when sufficient demand is made, a duly earned credit will be given for a fireproof first floor in residences. They took pains to state that the stairs and basement partitions should also be of fireproof construction.

Adaptability. In the above comparative costs we have considered that the same floor finish will be used for wood joist or for concrete joist construction. There are many methods of applying finished floors, all of which can successfully be applied to the concrete joist floor. Our record for number of different finishes used on a single job is five. This job has linoleum in the kitchen, brick finish for the den, wood for the living room, flagstone for the hall, and tile for the bath. No difficulty was encountered on the job and the architect was especially pleased at the ease with which the variety of floor finishes went into place. Many people do not even consider concrete floors until they are convinced that they may have their wood floor finish. We have found, however, that in many cases, after they learn that the wood floor finish is available, they change to some other type of finish, usually a plain or colored concrete. The difference in the cost of a first class hardwood floor finish and that of a plain concrete steel trowel finish will in many cases buy a nice rug for the room.

Simplicity. This is the part of the precast concrete joist floor that appeals especially to the contractors. These floors have no difficult parts and nothing complicated about them. In our work we have made all joists to order and every joist is marked. With each joist job we furnish a *detailed layout and setting plan*. We go further than that, and with the first job for each contractor we make sure that our engineer is there at the time of setting. In this way he gets the contractor off to a smooth start and has him pulling for concrete joists. We have had a little demand for stock sizes of concrete joists. However, I believe the business will first have to be developed along made-to-order lines before stock sizes can come into general use.

Decorative Possibilities. Smooth ceilings of plaster or plaster board can be applied to the under side of precast joists. However, this is slightly more expensive, and we have found that in most cases people prefer to paint or plaster the under side of the joist floor and obtain their finish in that manner. Practically all architects agree that the

concrete joist offers unlimited possibilities of decoration. This is a fortunate thing for the joist manufacturer, for it gives the architect the chance to express his individuality in decoration.

Sound Deadening. In the precast concrete joist floor there is sufficient mass to stop noises from traveling from floor to floor. In this respect we have found that a cinder concrete slab on the joist is a decided help. A concrete first floor will keep the machinery noises from the oil burner, the air conditioner, pumps, washing machine, etc., confined to the basement. Playrooms are very popular in the basement, and playroom noises stay in the basement with a concrete first floor. One of our jobs was an alteration job where, among other things, an addition was put on the living room. In the addition, they used the precast joist floor, the other half of the living room floor being of wood construction. Now they find, on walking the length of the living room, that the old part of the room is very noisy and the new part, on concrete joists, is practically noiseless.

Heat Insulating. With a concrete floor, there are positively no drafts or leaks through it, and when a cinder slab is used the heat insulating qualities are stepped up still further. They are a decided factor in helping to make a house easy to heat. On a demonstration house which we put up this winter, we had ice on top of the second floor cinder slab, and after the roof was put on we started the furnace. Without heat in the second floor we were unable to melt the ice until the weather man helped us.

Vermin, Insects and Termites. Rats, mice, and insects generally, find it much harder to get into a house with a concrete floor; and once they get in, they find it harder to go places in a house of this construction. When I was a boy, my father wrecked several old wood frame houses, and we used to watch for runways and storage places which the rats, mice and squirrels had used. Wood construction does not bother these pests in the least. Termites are becoming real factors in some localities. At the present time we are hearing most about them in our work along Long Island Sound. Anyone who has had experience with termites or has become interested in them is usually an easy person to sell on the idea of a concrete floor. One of our salesmen had been calling more or less regularly on an architect about concrete floors without any apparent success. However, one day this architect ran into a bad case of termites, and our salesman found him much more favorable to joists. Before our salesman left the office a prospect came in for some architectural work, and our salesman claims to have heard the greatest

sales talk ever given on precast concrete joist construction.

Strength. The matter of strength is of utmost importance and comes to the minds of those who are unfamiliar with reinforced concrete about the first thing when concrete joists are mentioned. My recommendation, from experience, would be first, to convince yourself and learn what your own joists will do by building test panels and loading them to failure. The next step would be a laboratory test by a recognized testing laboratory; or if a job is landed in a particular territory where there is a competent building inspector, by getting his co-operation you may be able to run the floor test for his satisfaction and in this way establish your floor joists as being sufficiently strong. At all these tests, except the one where you are convincing yourself, be sure to invite building inspectors, contractors, engineers, architects, news men, and anyone else that will help you spread the results of the test. Another big help is to set up a permanent display test. In this test work, by all means keep detailed records for future reference and don't omit any of the minor details. We have found that practically all floor joist jobs are tested on the job. It is not uncommon to find on a newly set concrete joist floor a truckload of cement, plaster, brick, or other materials piled on the center of a room floor.

Permanence. This is the part of the joist floor that appeals to the owner. When you can tell him that no rotting, warping, shrinking, or squeaking go with concrete floors, he is immediately interested. Then when you go on to show him there is no costly upkeep connected with these floors, he is more interested. We believe the concrete floor with a concrete finish offers the best possibilities for low upkeep costs.

Convince the Architects

In conclusion I would like to mention sales effort. We believe that most sales effort should be directed at the architect, because if the idea is first sold to him, it becomes his idea; and architects delight in selling their ideas to the owners. Owners in a few cases can first be sold on the joists, but almost invariably they will not use them without the architect's approval. We have found contractors who are thoroughly sold on joists always favored this construction for a fireproof floor. We have had four cases of contractors recommending in alternate bids the precast concrete joist floors where they were not specified by the architect. I believe the future for precast joists is promising if we take pains to have every job successful.

Just Out . . . New BRANFORD VIBRATOR SPADE

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This new Branford vibrator spade operates in a horizontal position—requires no spring for starting and operates at as low a pressure as 20 lbs. to 30 lbs. depending upon the slump.

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TYPE 1455-B. No. 1 size (shown at left) has a supplementary blade 24" long and 4" wide, corrugated, and is used as an attachment to the standard type 1455-A to produce a smooth, voidless surface, eliminating patching and finishing.

TYPE 1455-A. No. 1 size (shown at right) Blades are 12" long and 4" wide. This spade is especially designed for use between reinforcing and the inside face of the form.

Furnished standard with two 24" extension tubes—extra tubes in 2 ft. or 4 ft. lengths furnished extra.

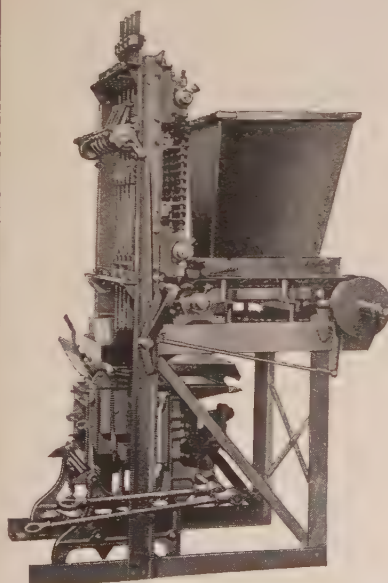
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Cinder Products Association

Is there an association devoted to the interests of manufacturers of cinder concrete products? Have the patents on cinder concrete block stood the test of the courts?—B. R. Y., Duluth, Minn.

The association about which you inquire is the National Cinder Concrete Products Association, 1600 Arch St., Philadelphia, Penna. The secretary is Harry H. Longenecker. The president of this association is Einar Christensen, consulting engineer, 122 East 42nd St., New York.

So far as the Straub patents are concerned, they expired in 1934. As to other patents that may be in existence, it would be very difficult to determine their present standing in law. Inasmuch as the association mentioned above is composed mainly of manufacturers that use the Straub process, we suggest that you join this group. In this way you would gain the benefit of the combined experience of manufacturers in this field.

Trouble with Segregation of Cinders

We are using ordinary cinders as an aggregate for concrete which we store in overhead bins having tapered bottoms and holding about a carload of cinders. When these bins are nearly empty a segregation of the cinders occurs. That is, with some batches we receive nothing but coarse cinders, while in other batches we receive mostly the fine material. This produces blocks of different texture, and it is objectionable.

Have any of your readers had trouble of a similar kind; and if so, can they suggest some way to avoid this difficulty?—P. M. C., Arlington, N. J.

The products manufacturer who has sent in this inquiry will be grateful to anyone who can suggest a successful method of avoiding the difficulty he is having with segregation of cinder aggregate in his storage bins. CONCRETE invites readers to let us know of similar

experiences, and how the trouble was overcome. Suggestions received will be forwarded to this manufacturer.

Litharge as an Acid-Resistant

Can you give us some information on the use of litharge as a material for protecting concrete against acids. The floors in several of our manufacturing buildings where sulfuric and nitric acids are present have a vitrified brick paving surface on a concrete base. Our problem is to protect this concrete base with an acid-proof material; and we would also like to use this same material in the joints of the paving bricks.

In an article headed "How Various Substances Affect Unprotected Concrete," on page 18 of the recent January issue of CONCRETE, mention is made of the use of litharge as an acid-resistant, but no information is given as to how it is applied or what other materials (if any) are mixed with it. We would appreciate receiving more complete information on the subject, as it applies to our particular case.—R. C. H., Rochester, N. Y.

As you know, commercial litharge is usually obtained in powder form, and sometimes in flake form. Chemically, it is a lead monoxide (PbO). In cases where reinforced concrete tanks are built to contain acids, they are often lined with glass plates or tile; and an excellent acid-resisting mortar in which to set these plates or tiles may be made of litharge mixed with glycerine as the vehicle. A coating is applied to the surface of the concrete, and the plates or tile are bedded into this coating, which also fills the joints between tiles.

In the problem you have in hand the situation is similar, though it is somewhat simplified because you are dealing with a horizontal surface.

Litharge, when mixed with glycerine as previously recommended, is able to resist both sulfuric and nitric acids. The same mixture may also be used as a cement for miscellaneous purposes, such as fastening porcelain bath-room fixtures to tile wall surfaces.

Rubber Molds for Objects in Concrete

A subscriber asks for the names and addresses of manufacturers of rubber molds for casting concrete objects such as dogs and other cast statuary. Readers who have had satisfactory experience with such molds will confer a favor to other products manufacturers by letting us know where they obtained the molds.

Low-Cost Concrete Homes

I have long been in the contracting business, and would like to know where to obtain information on low-cost concrete house construction, along the line discussed in your editorial in the March issue of CONCRETE.—F. D. J., Buffalo, N. Y.

The best source of information of the kind you request is the Portland Cement Association, 33 W. Grand Ave., Chicago, Ill. Ask them in particular for their books entitled *Low-Cost Fireproof Concrete Homes*, and *Concrete Facts for Concrete Contractors*.

Masonry Cements

Where can I get reliable information on masonry cements? It seems to me that every kind of cement that is not a true portland cement is thrown into one bag and is given the name of "masonry cement."—F. K., Tulsa, Okla.

Speaking figuratively, you have expressed the situation rather accurately. It is true that the term "masonry cement" is applied to a number of different kinds of cement, including (1) hydraulic lime, (2) natural cement, (3) blast furnace slag with various additions, (4) mixtures of portland cement and lime, (5) mixtures of portland and natural cements, and (6) mixtures of portland cement and various materials.

It is suggested that you write to the National Bureau of Standards, Washington, D. C., for a copy of *Research Paper RP-746*, by Jesse S. Rogers and Raymond L. Blaine, recently published in separate pamphlet form under the heading *Investigation of Commercial Masonry Cements*.

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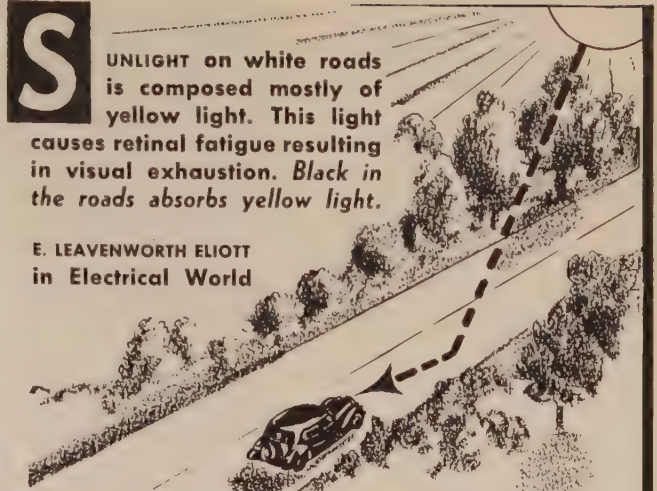


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New Books and Pamphlets

Forms and Centering

FORMS AND CENTERING, by A. B. MacMillan, chief engineer, Aberthaw Construction Co. Published by the International Textbook Co., Scranton, Penna. Cloth binding, 158 pages, 5 by 7½ in.; extensively illustrated with detailed drawings.

In this book many contractors will find the answer to their form construction problems, for the author has supplied clearly detailed drawings and descriptions of form work for various miscellaneous structures such as dams, retaining walls, circular bins and tanks, culverts and sewers, as well as for buildings and bridges.

The broad and all-inclusive scope of the book is indicated by the following headings of the separate chapters:

- (1) General Requirements of Form Construction.
- (2) Construction Principles.
- (3) Construction Materials.
- (4) Forms for Buildings.
- (5) Forms for Footings.
- (6) Forms for Walls.
- (7) Forms for Columns.
- (8) Forms for Flat-Slab Floors.
- (9) Forms for Beam-and-Girder Floors.
- (10) Forms for Miscellaneous Building Details.
- (11) Form Make-Up and Erection Schedule.
- (12) Forms for Miscellaneous Structures.
- (13) Forms for Retaining Walls and Dams.
- (14) Movable Forms for Circular Bins and Tanks.
- (15) Forms for Channels, Culverts, and Sewers.
- (16) Forms for Bridge Construction.
- (17) Forms for Road and Street Construction.

Every contractor should own several copies of this excellent book—one for himself and one for each of his construction superintendents.

Concrete Structures to Prevent Soil Erosion

EXPERIMENTAL INVESTIGATION OF THE HYDRAULICS OF DROP INLETS AND SPILLWAYS FOR EROSION CONTROL STRUCTURES is the title of a 66-page, well illustrated booklet by Lewis Hanford Kessler, published by the Engineering experiment station of the University of Wisconsin, Madison, Wis. Price 25 cents a copy.

Numerous illustrations of concrete drop inlets and spillways, built in conjunction with earth-fill dams across ravines and gullies, are shown. In his reference to the soil-saving work in Wisconsin, the author explains that "with prospects of constructing 300 to 400 finished earth dams from 10 to 40 ft. high with 1,800 CCC workers, it appeared that something more substantial than sewer pipe would have to be used for conduits. Reinforced concrete seemed to be the best means at hand. Furthermore, the materials for the concrete cost less than the sewer pipe or corrugated pipe delivered to the job. Money was limited for the purchase of materials. Hence, concrete fitted in well with a project that was short on money and long on labor."

Concrete Pavement Manual

CONCRETE PAVEMENT MANUAL, published by the Portland Cement Association, 33 W. Grand Ave., Chicago. Copies free, on request.

Highway engineers will find this 72-page book a valuable addition to their engineering literature on highway pavement design and construction. It is complementary to *Concrete Road Design*, published at an earlier date by the association. It treats additional problems in design, and it outlines the best construction methods. Summaries of data on pavements from recent technical society proceedings, current literature, tests and experience are included.

House of Health—Fireproof

THE HOUSE OF HEALTH—HOW TO BUILD IT, by Odd Albert. Published by the Opla Company, P. O. Box 66, East Orange, N. J. Heavy paper cover, 80 pages, 8½ by 11 in., extensively illustrated. Price \$1.00.

Fireproof wall and floor construction of various types, fireproof roofs, insulated walls, weatherproofing details—all these constitute features of the author's conception of the house of today. The book shows the older methods of construction as well as the newer and more modern methods, all of which are shown in detailed drawings and explained in the descriptive text.

This volume should be in the hands of every architect, every contractor, and every manufacturer of concrete products employed in building construction. In its construction details alone it is worth many times its cost.

Winter Paving

(Continued from page 4)

Four of the 7-day test specimens and eleven of the 14-day specimens did not break under the maximum stress applied by the testing machine. Inasmuch as these unbroken specimens were recorded as if they had failed at the maximum applied stress of 1,000 lb. per sq. in., the actual average strength of the concrete at the ages of 7 and 14 days must have been somewhat higher than indicated in Table 2.

Rapid Hardening Under Covering

The lowest single break at the age of 7 days occurred at 755 lb. per sq. in. The lowest at 14 days was 654 lb. per sq. in. However, three times as many specimens were broken at the age of 14 days as at 7 days, so that the breaks showed a wider range of values.

Acknowledgment: The Pronger Construction Co., of Blue Island, Ill., was the contractor on this project, which was described briefly in last month's issue of *CONCRETE*. The work was built under the supervision of the Illinois Division of Highways, of which Ernst Lieberman is chief highway engineer, and C. M. Hathaway is engineer of construction. K. L. Harger is district engineer for district No. 10. W. A. Reinert was resident engineer for the Division of Highways, and tests were conducted under the supervision of R. A. Lonier, engineer of materials for district No. 10.

Private Building in South on Increase

AN increase in excess of 90 per cent in private activities in the South during the first quarter of 1935, as compared with the corresponding period of 1934, is reported in a survey conducted by *Manufacturer's Record*.

Residential construction was in line with other kinds of occupancy, the increase having been in almost the same proportion as with all private construction.

The results of this survey become especially significant when considered from the fact that the figures cover a period of three months, and a large geographical area. And the reports include private construction only.

While this region will get its allotments calling for the expenditure of millions of dollars in work-relief funds for permanent public construction, the increase in private construction is regarded as an indicator of definite promise for the rest of the country.

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CONCRETE SPECIALTIES— How to Make and Sell Them

A 64-page booklet, entitled "How to Make and Sell Concrete Specialties," was published by the Concrete Publishing Company in 1928, and was distributed quite extensively throughout the concrete products industry.

Individual chapters cover the following subjects: (1) Analyzing the market for concrete specialties; (2) concrete burial vaults; (3) concrete septic tanks; (4) concrete fence posts; (5) concrete sills and lintels; (6) concrete silo staves; (7) concrete roofing tile; and (8) concrete floor tile.

A limited number of copies of the booklet, just made available, can again be offered to readers of "Concrete" while the supply lasts, at the reduced price of 50 cents a copy, which is half the publisher's price of \$1.00.

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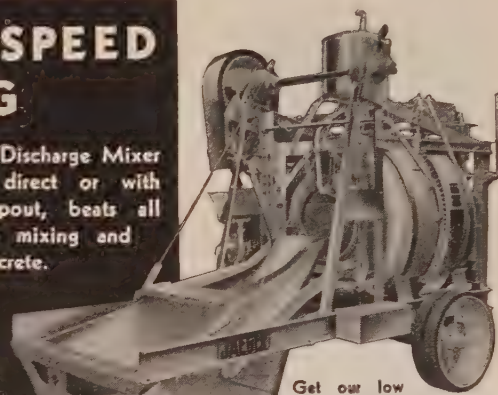
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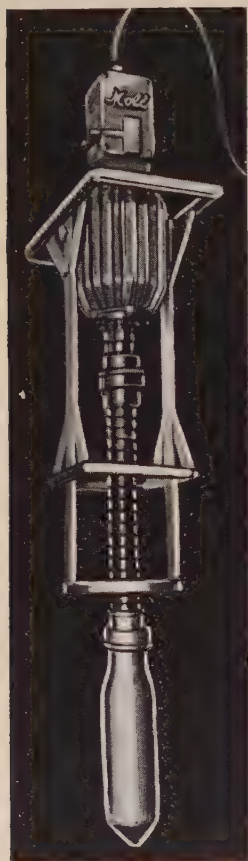
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EQUIPMENT AND MATERIALS

MALL—a new type electric combination internal, mass and form concrete vibrator for placing low slump, mass and form concrete is announced by the Mall Tool Company, Chicago, Illinois.

The motor and vibrator in this unit are short coupled and the entire machine can be carried and operated by one or two men. The machine weighs 140 pounds and the overall length is 5 ft. 6 in.

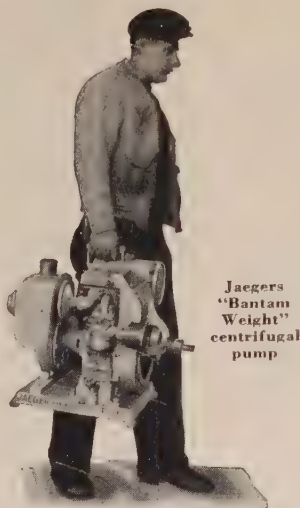


New Mall electric combination vibrator

As a flexible shaft vibrator, the same motor can be used with either 14, 21 or 28 ft. of flexible shafting, depending upon the requirements in reaching the vibrator into the inaccessible points of the form.

BANTAM Weight pump, developed by the Jaeger Machine Co., Columbus, Ohio, is powered with a 2½-hp. engine and is rated at 8,500 gallons per hour capacity—greater horsepower and capacity than hitherto available in light weight self-priming centrifugals. Weight saving has been accomplished by the compactness of design and the use of aluminum and alloy steel construction, producing a rugged, powerful outfit which is also portable

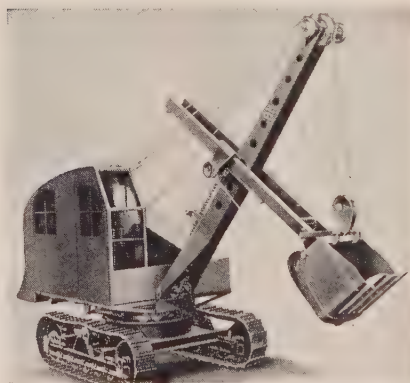
enough to be picked up with one hand, carried anywhere and set to work on any-



Jaegers "Bantam Weight" centrifugal pump

thing from slow seepage to continuous, big volume pumping, the makers say.

P & H "Bantam Weight" is a new full-revolving ¾-yd. excavator, known as the Model 100, announced by the Harnischfeger Corporation of Milwaukee. Weighing approximately 15,800 lb., this new machine is fully convertible at a new mini-



P & H "Bantam Weight"

mum of time and expense for a wide range of uses among contractors, material yards, industrial plants, highway commissions, quarries, etc.

The Ford V-8 truck motor delivers 40 hp. at 1,300 r.p.m. with ample reserve for all operations. Diesel power is also available.

UNIVERSAL TWISTYES — just announced by the Universal Form Clamp Co. of Chicago—combine an improved clamp that is said to have ample take-up and

sufficient bearing surface with a strong spreader tie that may be twisted off an inch back of the wall face without removing the forms.

The clamp consists of a specially hardened steel wedge integral with a steel bearing plate—2 in. wide and 3½ in. long.



Universal Twistyes and improved clamp

The ample take-up of the wedge is said to be a real asset in overcoming irregularity in lumber sizes.

THE ROBINSON Air-Activated Conveyor is a patented device, invented and manufactured by E. Gwynn Robinson, New York City.

About a year ago, the Spencer, White & Prentis Company, of New York City, were awarded Lock No. 6 on the Mississippi River, at Trempealeau, Wisconsin. This job required the unloading of 85,000 barrels of cement from railroad cars to their storage silos. The layout called for 500 ft. of conveying distance. The Robinson Air-Activated Conveyor was purchased for the work.

Since completing the lock, the same firm was awarded the dam connected with Lock No. 6. This dam calls for an additional 40,000 barrels of cement. After moving the 85,000 barrels, the device is in perfect condition for the continuation of the work on the second contract, the manufacturer says.

Due to the splendid performance of the conveyor on this job, and other installations, it was recently purchased for a dam job at Grafton, West Virginia, where it will handle 1,200,000 barrels of bulk cement, to be moved at the rate of 6,000 barrels per day.

The device is operated only by air, eliminating all moving and wearing parts. The system consists of a pressure tank, with an air-operated cut-off gate, which shuts off the cement when the desired amount has entered the tank. Compressed air is then turned into the tank and, through air jets, made fluent. After sufficient pressure has been built up, a valve on the conveying line is opened, and the aerated cement flows through the conveying line at such speed as to reduce the cost of operation, to an astoundingly low figure, it is claimed.

Pulverizing in Cement Manufacture

Direct Firing of Kilns Possible Without Need of Separate Drying Operation—Hot Air Passed Through Pulverizers —Records at Several Cement Mill Installations

IN the ball thrust-bearing we find a principle as ideally suited to the work of grinding as the wheel and axle are to transportation. The ball-bearing type of grinding element has many advantages over the roller types. It requires no axles, and hence no lubrication, and has very little friction. The balls, rotating spirally, in a circular path, wear down uniformly and continue to fit the race throughout their life. Not being dependent upon centrifugal force for their pressure, slow speeds and high pressures can be used. The correctness of this "ball-bearing principle" of grinding has been demonstrated commercially during the last five years only, as the development of the proper arrangement of grinding elements, flow of air and material, and the most efficient ball pressures were required.

An Air-Swept Pulverizer

An air-swept pulverizer of ball-bearing principle, as installed commercially during the last five years, is shown in Fig. 1. It has two rows of 9 $\frac{1}{4}$ -in. diameter balls arranged similar to a double, ball thrust-bearing, with the bottom race stationary, the intermediate race driven through dogs by the main shaft, and the top race floating but restrained from turning by stop lugs. Pressure is applied to the top race by means of the springs. The springs are calibrated, and the pressure obtained is easily determined from measurements of their lengths.

When used for pulverizing coal, the coal is fed to the inside of the upper row and is carried outwardly through the balls by centrifugal force, and drops through the restricting ledge gap into the path of the lower row of balls.

Hot air from the windbox passes through ports underneath the bottom ring, passes upward through the throat, picking up the coal as it emerges from the inside of the lower ball-race, and carries it outwardly through the ports in the intermediate ring. Here the air slows down, drops the larger particles, scavenges the fines from the stream of coal dropping from the upper row, and then carries the coal to the upper part of the pulverizer, where the oversize particles drop from the air-coal stream to the center of the upper row of balls.

Separate Dryers Eliminated

During the last three years, 83.5 per cent of the pul-

verizing capacity sold was for direct-fired plants; and, during the first ten months of 1934, 90.5 per cent of the capacity sold was for direct-fired plants. The pulverizers illustrated are ideally adapted to direct firing as well as to central systems. The use of hot air directly in the pulverizers for drying the coal has eliminated the necessity for separate dryers. The evident advantages of the direct-fired system as compared to the central systems are (1) a simple plant that is low in first cost, (2) elimination of the separate pulverizer plant, (3) reduction in operating labor, and (4) complete elimination of the dust nuisance.

The power required by pulverizers varies inversely as the grindability of the coal. Typical figures may be given as 15 kw. per ton for pulverizer and fan for mid-western coals of 50 grindability, to 10 kw. per ton for eastern semi-bituminous coals of 100 grindability. The maintenance cost has practically no relation to grindability, but varies with the abrasive qualities of the coal and is appreciably increased with coals high in pyrites.

The ability of a pulverized-coal-fired furnace to burn all grades of coal, having low or high fusion-temperature ash, in all sizes from the finest dust to run-of-mine with an almost negligible ash-pit loss, a low carbon loss in the flue dust, with low excess air, and with a flexibility and ease of control that is incomparably better than can be obtained with stokers, make it the most suitable method of burning coal.

Direct Firing of Kilns

Cement kilns have been fired by pulverized coal for many years; but, until recently, most installations were of the central plant type having a separate pulverizing building, dryers, and an attendant serious dust nuisance. The same advantages exist for direct firing of kilns as for direct-firing of steam boilers. Kilns, however, require a high and uniform fineness and a high degree of reliability. These characteristics could not be obtained in the earlier types of direct-firing pulverizers on the market, especially those of the impact type. Now that direct-firing pulverizers of the ball-bearing type have demonstrated in steam plants that they can reliably deliver coal of high fineness, their use in firing kilns is quite attractive.

A typical installation firing a cement kiln in a Hudson River plant is shown in Fig. 2. The installation is similar to steam boiler installations, with the exception of an air by-pass around the pulverizer, as it is desirable in kiln firing to control the length of the flame in the kiln. This

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control is obtained by adjustments of the by-pass, which result in variations in the quantity and velocity of the primary air without causing variations in the flow of air through the pulverizer. The gains in labor cost, simplified plant, and elimination of the dust nuisance are all realized; but, in addition, the combustion results are much better than are obtained with a central system. The uniform feed of coal, together with the perfect dispersion of the coal particles in the primary air, result in early igni-

burned carbon can and does escape from the kiln in the flue gases when the feeding is irregular or the dispersion imperfect. The exact amount of this unburned-carbon loss can be determined by analysis of a sample of dust from the flue gases. The dust sample can be freed of carbonates by leaching with acid, and the carbon determined by ignition in a combustion tube.

Dry Coal Not Necessary

The belief has existed that the use of dry coal was required to obtain the necessary temperature and best efficiency in the kiln, and that, although direct firing might be possible with low-moisture eastern coals dried in the pulverizer with hot air, it would be impractical with higher moisture mid-western coals. The results of some calculations on this problem, assuming a constant amount of heat lost by radiation, disclose that the temperature drops as the moisture increases, but not very rapidly. The temperature can, however, be maintained if the coal feed is increased, so that slightly more coal is added than would be required for the dryers. The increased volume of gases, however, will burn more clinker, so that the probable increase in coal consumption per barrel can be estimated at approximately six per cent for 15 per cent moisture, or three per cent more than is required for the dryers. This three per cent surely would not pay for the labor to operate the dryers. Actually, the losses in the vents of the dryer and pulverizer of a central system are usually more than this three per cent difference.

Actual experience in the direct firing of a cement kiln in the middle west has demonstrated that coal having 19 per cent moisture can be fired with no higher coal rate than is required for the central kilns. Extended operation with coal having 12 or 14 per cent moisture, and starting up cold with this coal, has demonstrated the practicability of direct firing kilns with high-moisture coals.

An application of this pulverizer to the direct firing of a lime kiln in Ohio is also proving satisfactory with Ohio and Western Pennsylvania coals.

Closed-Circuit Systems

The success of the large coal pulverizer at Kips Bay Station of the New York Steam Corporation, where more than 54 tons per hour of Western Pennsylvania coal was pulverized with low power and maintenance, naturally led to the trial of the ball-bearing pulverizer on raw cement rock. Laboratory trials in which the raw material was passed through the pulverizer without the use of air, indicated that better efficiency could be obtained by using the pulverizer in this way in closed circuit with an external air separator than was possible if used as an air-swept pulverizer. The first installation of the closed-circuit type pulverizer was made at the Whitehall Cement Manufacturing Company's plant at Cementon, Pennsylvania. The general arrangement of the system is that the raw material is fed by a weighing feeder or poidometer. After passing through the pulverizer, it is lifted by the elevator and discharged into the air separator. The oversize material is returned to the pulverizer, and the finished product is discharged to the pump. A small amount of air is vented from the pump hopper through a fan and a cyclone.

The material is passed down around the center shaft, is spread out over the revolving table, and thrown off the edge in a thin film. A current of air passes up through this film, lifting the finished particles while the oversize

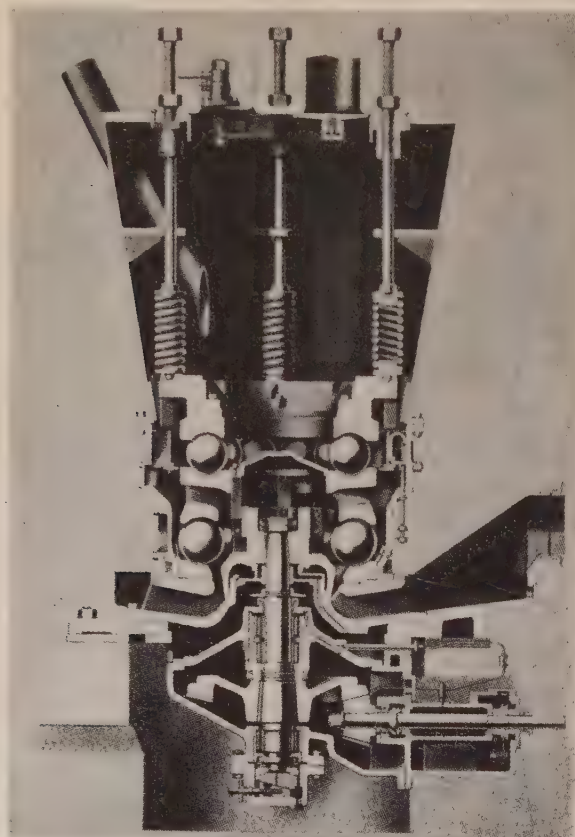


Fig. 1 (Above)—Hot air-swept pulverizer of modern type eliminates separate coal-drying operation

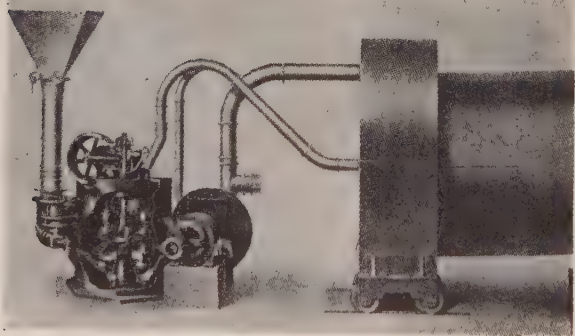


Fig. 2 (Below)—Pulverizer arranged for direct firing of cement kiln in Hudson River plant

tion and complete combustion. The actual results show a lower coal rate per barrel for the direct-fired systems.

Many cement plant operators believe that all unburned-fuel losses are detected as CO in the flue gases. Actually, CO is difficult to form in the combustion of pulverized coal; and, when it is found, it is usually caused by excess or coarse coal dropping to the bottom of the kiln, where the reduction of CO₂ to CO is possible, through contact with a solid mass of incandescent carbon. Actually, un-

particles drop to the bottom of the inner cone. The distributor blades break up any remaining clusters. The fines are carried by the air current inwardly through the adjustable valve plate and through the fan at the top. The swirl produced by the fan separates the fines from the air in the outer annular chamber, and the fines drop to the bottom of the outer cone while the air enters the inner cone through the louvers and begins another cycle. The fineness is adjusted by varying the valve opening and by varying the number and size of the distributor blades.

The Whitehall Installation

The pulverizer installation at Whitehall is shown in Fig. 3. The construction of the pulverizer is similar to that of the large coal pulverizer, as three rows of balls are used. The bottom ring is stationary, the intermediate ring rotates, being driven through four lugs meshing with the yoke on the main shaft. The two top rings are floating rings and are held from rotating by stops on the housing. Two separate sets of four springs each apply pressure to the top rings. The material is fed to the center of the pulverizer. It passes through the inner row of balls, then through the outer row, and is held back by the reverse ledge to maintain a level of material around the balls. It then drops to the lower balls, feeds inwardly through them and drops to the discharge sweep below.

The main shaft runs at 80 r.p.m., and the balls actually run at half this speed, or 40 r.p.m., which is a relatively low speed. The springs exert a pressure of 1,200 lb. per ball on the outer row of balls and 2,000 lb. per ball on the inner row. The centrifugal force of the balls of the inner row is 227 lb., or 11.3 per cent of the ball pressure. The centrifugal force of the outer balls is 156 lb., or 13 per cent of the ball pressure. Centrifugal force is, there-

fore, a small factor, and the resulting pressure is nearly vertical and always under control through adjustment of the springs.

For harder materials, higher pressures are used. For grinding clinker, the pressure on the outer row is 2,000 lb. per ball and on the inner row 2,700 lb. per ball.

Three-Year Record at Whitehall

The output was weighed continuously by the poidometer and the power required was measured by a recording and integrating watt-hour meter on the pulverizer motor. An integrating watt-hour meter on the separator and elevator and an integrating watt-hour meter on the pump and air compressor were used to measure the power required by these auxiliaries. Indicating ammeters were installed on the pulverizing motor and separator motors. A power relay was used to control the feeder speed and thereby maintain a constant load on the pulverizer motor.

Thus, each day's operation constitutes an accurate test, and hourly readings have been taken by the operators during the three year's operation.

Early operation indicated the desirability of carrying a recirculating load of seven to ten times the output, which was very much larger than was the practice with other closed-circuit systems. The elevator capacity soon proved to be a limiting factor. Numerous minor changes resulted in increasing the elevator capacity, with resulting increases in the capacity of the unit.

Summary of Results

The results obtained are summarized as follows: During the first seven months, the operation was all at a fineness of 90 per cent through the 200-mesh sieve, and an average capacity of 117 barrels per hour was main-

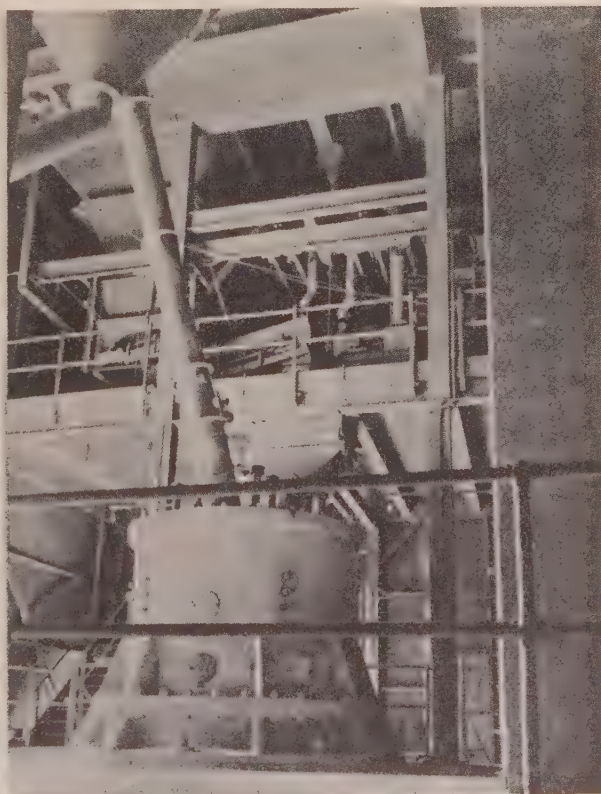
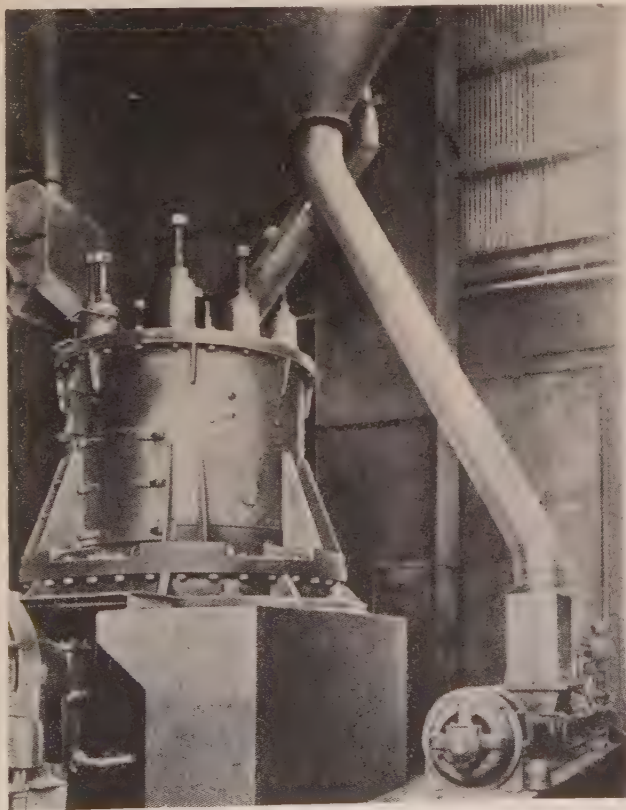


Fig. 3 (Left)—Pulverizer at Whitehall Cement Manufacturing plant, hooked up in closed circuit with external air separator

Fig. 4 (Right)—Alpha's new pulverizer installation hooked up with air separator, in raw grinding department of plant at Catskill, N. Y.

tained for 42 consecutive days, and similar output during most of the time. The power required per barrel for pulverizer, elevator, and separator was 2.75 kw-hr., or just about half that required by open-circuit preliminary and tube mills of modern design.

Operation was then changed to clinker grinding, during which the size of the elevator buckets was increased. In 1933, a series of tests was run to determine the capacity of the unit on raw material with this increased elevator capacity. The curve shows that a capacity of 139 barrels per hour was obtained. Other tests were run at a fineness of about 65 per cent through 200-mesh to determine the practicability of using the pulverizer as a preliminary unit.

In 1934, it was decided to use the unit for raw material grinding entirely, as more power could be saved by operation on raw material than on clinker. Due to the arrangement of the plant, it was necessary to run the raw material through a tube mill in order to mix the kiln dust with the raw material. It was then found more economical to do practically all the grinding in the closed-circuit unit, and the tube mill was speeded up so that it functions practically as a mixer. Recent operation has all been at 85 to 87 per cent through 200-mesh. For several hours at a time, a capacity of 176 barrels per hour, or 53.3 tons per hour, was maintained. It is significant that during 1932 and 1933 the manufacturer had a representative observing operations, while during 1934 no representative was present. Operation was entirely in the hands of the regular operators. The operation is entirely automatic, and the operators' main duties consist of starting up the equipment and shutting it down once a day.

Grinding Clinker

From July, 1932, to December, 1933, the operation was entirely on clinker except for about two weeks, when special tests were made on raw material.

Most of this time a fineness of 90 per cent through 200-mesh was maintained, and outputs of 90 to 110 barrels per hour were obtained in daily runs. Special tests at higher fineness were run to determine the characteristics. A power consumption of 4.2 kw-hr. per barrel again indicates a saving when compared to 5.6 kw-hr. per barrel required for the usual preliminary units and tube mills. The saving is not as large as is obtained on raw material but is still substantial. The particle-size distribution of the pulverized clinker was carefully studied, first by the Reed-Lewis apparatus and later by the Wagner Turbidimeter.

The grindability of raw material averaged about 75, while that of the clinker averaged 30, which accounts for the large difference in capacity obtained.

The Alpha Performance Record

A similar unit installed at the Catskill plant of the Alpha Portland Cement Company in the spring of 1934 gave daily average capacities of 103.5 barrels per hour, which, when plotted at its grindability of 57, is consistent with the other test points. In the summer of 1934, larger elements were installed in this pulverizer, and, since then, capacities of 123.5 barrels per hour have been obtained.

The fineness of the pulverizer discharge is approximately 20 per cent through 200-mesh for both raw material and clinker. With a 200-mesh content as low as this, it is evident that practically no cushioning of the grind-

ing elements takes place, which accounts for the high efficiency of the unit.

The circulating load averages around 300 tons, with peaks of 350 tons per hour. The ratio of circulating load to output varies from four to nine for raw material and from 16 to 23 for clinker. For a fineness of 90 per cent through 200-mesh, the ratio is eight for raw material and 16 for clinker.

One of the most desirable characteristics of the unit is the low temperatures resulting when clinker is ground. At a fineness of 90 per cent through 200-mesh, with a feed temperature of 170 deg. F., the temperature of the pulverizer discharge was 269 degrees, that of the tails 250 deg. F., and that of the finished product 188 deg. F.

A study of the grindability of raw materials and clinkers is very interesting. In all, about 300 raw materials and clinkers have been tested. The grindability of Whitehall clinker, 30, is about the lowest of any clinker tested, whereas the grindability of the raw material, 75, is a fairly representative grindability of the raw materials obtainable throughout the country.

Maintenance

Although the saving in power is the major advantage to be gained by the use of the ball-bearing type of pulverizer, the rate of wear of the grinding elements is low enough to effect substantial savings in maintenance over that of the tube mills and preliminaries. The plant at Whitehall has been fortunate in that, during the two years since this pulverizer was installed, the plant was idle only 3½ months. To balance the steam load, however, the grinding of raw material and clinker was alternated either every day or every 12 hours. It was possible, therefore, to operate this unit only half of the time. Up to December 7, 1934, the unit has operated 3,002 hours on raw material and 3,322 hours on clinker.

Based on this length of operation, a set of parts can reasonably be expected to last, on the average, 8,000 hours when grinding raw material, representing a cost of 0.27 cents per barrel for parts.

Evidence that there is no relation between grindability and wear of grinding parts is found in a comparison of the rates of wear in the pulverizers at Whitehall and Catskill. The wear of the parts in the pulverizer at Catskill is only two-thirds that of the parts in the pulverizer at Whitehall when operating with raw material. This difference in wear is due to the fact that some rocks of very low grindability may not be as abrasive as those of higher grindability.

When clinker is the material ground, the parts will require more frequent replacement, for which an average of 1.08 cents per barrel for parts is a conservative estimate.

There is now installed in the Whitehall pulverizer an intermediate ring having a central steel frame and three chilled alloy-iron shoes. This ring shows only about half as much wear as the one-piece alloy-steel ring used previously and, for clinker, at least should reduce the maintenance. The maintenance costs estimated for the ball-bearing pulverizer of 0.27 cents per barrel for raw material and 1.08 cents per barrel for clinker are less than those for the tube mills and preliminaries usually used.

It is significant that less than 10 gallons of lubricating oil have been used in the unit in 2½ years. The oil was

(Continued on page 40)

Portland Cement and Sulfuric Acid from Gypsum Anhydrite

Concluding Article of Series Describes Sizes and Capacities of Various Equipment Installations and Facilities Provided at Manufacturing Plant at Leverkusen

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THIS concluding installment of this paper describes the kinds, sizes and capacities of the various machinery, equipment and facilities provided at the manufacturing plant at Leverkusen, designed for the production of portland cement, slag-portland cement and sulfuric acid, from gypsum anhydrite.

Handling the Kiln-Exit Gases

The clinker is transported from the cooler with the aid of a "torpedo" and an elevator, to the clinker storage building. As shown in Tables 10 and 11 (page 39, April issue), the flue gases leaving the kiln contain 7.5 per cent of SO_2 , by volume. They have a temperature of about 750 deg. C., and are subjected to a partial cleaning from dust in a cooling chamber. The warmth of the flue gases may be utilized for burning natural gypsum to plaster gypsum in a drying drum with a heating tube. In this latter case, to prevent liquefaction of the gases, they should be directed through the heating tube, from which they are conducted directly to the gas pipe line leading to the sulfuric acid plant. These gases may also be used in a preliminary way for warming the air used for drying the raw materials, by means of an air-economizer installation.

To regulate the draft in the rotary kiln, there is installed at the end of the cooling chamber a refractory distributing valve, and the transportation of gas in the pipe line is effected with the aid of an exhauster. At the discharge end of the gas pipe line the gases are subjected to a definite cleaning in an electrical dust precipitator of the Cottrell type.

Changing SO_2 to SO_3

The conversion of sulfur dioxide (SO_2) to sulfuric acid will be accomplished by the Peterson tower method, which is less susceptible to changes in the SO_2 content in the gases than is the case with some other methods. However, the contact method, by means of a vanadium catalyzer, could be employed here to good advantage.

Since the kiln-exit gases contain only 1.2 per cent of oxygen, by volume (See Tables 10 and 11, page 39, April issue), the sulfur dioxide (SO_2) content being 7.5 per cent, by volume, it will be necessary to supply an additional quantity of oxygen to accomplish the oxidation of SO_2 into SO_3 . This addition of oxygen can take place at the sulfuric acid plant. In the gas to which oxygen has been added, the SO_2 content will drop from 7.5 per cent to about 7.0 per cent, by volume, and the oxygen content will be increased from 1.2 per cent to about 7.6 per cent, by volume.

Clinker Storage and Gypsum Departments

The clinker storage capacity is calculated for one month's storage of clinker. On the basis of 30,400 tons of clinker per year, this will require a storage capacity of 2,530 tons, or 1,790 cu. meters.

The clinker storage building is served with an electrically-operated bridge crane, which also transports clinker to the gypsum-clinker dosing station. The gypsum will be transported from the raw materials storage to ribbed rollers; and from here, after being crushed, it is conveyed to the gypsum bunker situated over the cement mill, side by side with the clinker and slag bunkers.

The quantity of gypsum required, based on the maximum addition of 3 per cent, by weight, of the slag-portland cement produced, is 0.29 tons per hour, 6.08 tons per day, and 1,824 tons per year.

Transportation of clinker from the clinker storage building to the bunker situated over the cement mill is accomplished with the aid of an electrically-operated bridge crane.

The Slag Department

The basic granulated blast-furnace slag arriving at the plant is unloaded at the slag-storage building, which contains provision for 15 days' storage. The wet granulated slag is transported from the storage building to the bunker over the drying drum. This bunker holds a 20 hours' supply. A feeding plate aids in the delivery of the slag to the drying drum.

For the drying of slag there is installed a direct-current drying drum 7 ft. 2 in. in diameter and 65 ft. 7 in. long. The power required is 14 hp. The output with raw slag having the maximum moisture content of 25 per cent is 10 tons per hour (39.6 per cent reserve capacity).

The consumption of slag, in tons, is shown in Table 18.

TABLE 18—CONSUMPTION OF SLAG, IN TONS

	Per hour	Per day	Per year
Raw slag, with moisture content of			
25 per cent.....	6.04	126.72	38,000
Dry slag	4.85	101.52	30,400

The dried slag is transported to the slag storage building, and from there to the bunker over the cement mill. If dry granulated slag can be made available, direct transportation of the slag to the storage building (without drying), and from there to the bunker over the mill, is foreseen.

Cement Milling Department

The output of the cement milling department, in tons, will be 9.67 tons of slag-portland cement per hour, 203.04 tons per day, and 60,800 tons per year.

The dry slag, the clinker and the gypsum are discharged from the bunkers over the mill, all of which have a calculated capacity of 10 hours' operation of the mill. These materials are fed into the mill by the aid of automatic feeders of the Krupp type, in the proportion of 50 per cent of portland cement clinker and 50 per cent of basic blast-furnace slag, and gypsum to the amount of 2 per cent of the combined quantity of clinker and slag. The three materials are then ground together in a 3-compartment compound mill of the Polysius type, which has a diameter of 7 ft. 2 in. and a length of 42 ft. 8 in. Its power consumption is 725 hp. The output is 14 tons per hour (46.5 per cent reserve capacity), with the fineness of grind such that 6 to 7 per cent is retained on a 4,900-mesh sieve (178 meshes per lin. in.).

The finished cement is transported through an underground screw conveyor to the boot of the elevator at the cement silos, and into the silos.

Silos and Packing Department

The capacity of the silos for the storage of the finished cement is calculated for a month's output of the plant. On this basis, the required volumetric capacity is 3,370 cu. meters, the weight of 1 cu. meter being figured at 1.5 tons. The actual volumetric capacity is 4,210 cu. meters.

Owing to the possibility of building three silos directly on the ground in a row, the cement being delivered by means of chain conveyors, the construction cost was re-

TABLE 19—SULFUR-CONTAINING PRODUCTION, IN TONS, PER TON OF CLINKER

	At the test plant, in tons	At the Leverkusen plant, in tons
Sulfurous anhydrite (SO ₂)	0.705	0.70
Sulfuric anhydrite (SO ₃)	0.871	0.77
Sulfuric acid (H ₂ SO ₄)	1.070	0.95

duced by about 30 per cent below the original estimate. Each of the silos is 29 ft. 6 in. in diameter and 73 ft. 9 in. high.

As has been mentioned before, the cement is transported from the mill to the silos through an underground screw conveyor and an elevator, the latter delivering it to a second screw conveyor above the silos. This upper screw conveyor distributes the cement to the three silos.

The required rate of discharge from a silo, based on 2,100 hours of work yearly, is 29 tons per hour.

The packing department provides for the loading of cement in bulk, for packing in barrels, and in paper bags.

Finally, Table 19 shows the quantity of our sulfur-containing production, in tons, per ton of clinker, at the test plant and at the Leverkusen plant.

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Pulverizing

(Continued from page 38)

removed once, and, after being filtered, was found to be very clean and as good as new oil.

The Alpha Installation

The installation made by Alpha Portland Cement Company at Catskill in the summer of 1934 is part of a rebuilding program that included the removal of their entire raw grinding plant, consisting of four ball mills and four tube mills driven by a lineshaft, and its replacement by one closed-circuit unit similar to the pulverizer in operation at Whitehall.

The unit is located in a new building especially designed for it and represents a very creditable installation. Fig. 4 shows the unit from the operating floor. The main elevator is shown at the right and the weigh-ometer in the background. The elevator used at Whitehall is a

centrifugal-discharge type running 280 ft. per minute. The elevator at Alpha is a slow-speed continuous-discharge type running 80 ft. per minute.

A third unit of the same size is now being installed by the Spokane Portland Cement Company, at Spokane, Washington. This unit is unusual in that it is planned to grind clinker three days, and raw material one day. The setting of the separator is not much different for 90 per cent through 200-mesh with either raw material or clinker and can be readily taken care of by valve adjustment. The speed of the poidometer will require changing when a change is made from one material to the other, the drive being arranged so that the changes in speed can be made quickly.

Acknowledgment: The installations here described and illustrated were manufactured and installed by the Babcock & Wilcox Company, of New York.

EDITORIAL

Retrograde Nomenclature

CONCRETE is not trying to qualify in the purist class, but it does wish to protest mildly—not too mildly—against some of the misusages in nomenclature that are establishing themselves so rapidly in the cement industry. It seems that the industry not only preserves carefully its own incorrect expressions, but acquires some from the outside. A few examples may be mentioned—there are many of them.

Consider the four principal compounds present in clinker: tricalcium silicate, dicalcium silicate, tricalcium aluminate, and tetracalcium aluminoferrite. If these had been known before the nineteenth century, the only notation available for them would have been something like this:



Since 1814, however, the notation of Berzelius has been in use and the compounds are expressed properly by the following formulas: $3\text{CaO} \cdot \text{SiO}_2$, $2\text{CaO} \cdot \text{SiO}_2$, $3\text{CaO} \cdot \text{Al}_2\text{O}_3$, and $4\text{CaO} \cdot \text{Al}_2\text{O}_3 \cdot \text{Fe}_2\text{O}_3$. In Rankin's paper, published by the Journal of the Franklin Institute in 1916, the formulas for the first three of these compounds appeared in the correct form (the fourth was not known at that time). However, in some way or other, pseudo formulas have found their way into the literature and appear to be gaining rapidly in popularity. These are C_3S , C_2S , C_3A , and C_4AF . They have only one merit—that of convenience. Surely some abbreviations could be found which would be convenient, and at the same time would not interfere with notation that has been used for more than a century, in one of the most important sciences. For instance, $3\text{C} \cdot \text{S}$, $3\text{C} \cdot \text{A}$, and the like, could be employed.

C_4AF would be the formula for *carbon argon fluoride*, if such a compound could exist—not a single symbol corresponding to the calcium, aluminum, iron, and oxygen really present. An amusing story is told of a manufacturer who went to a technical school for some aid in proportioning raw materials. He mentioned limestone, shale, and iron ore, and said he wished to increase the C_4AF . The technical school, knowing only correct chemistry and not being familiar with the pseudo formulas, was at a loss to understand the source of the fluoride.

As another example, we may mention the variety of names that are applied to simple inorganic compounds. Thus, CaCl_2 is called *calcium chloride*, *lime chloride*, *calcium muriate*, *lime muriate*, *muriate of calcium*,

and *muriate of lime*. Only the first of these is good usage. The others are either out of date or incorrect, and should never be used.

The third example is an expression such as *eighty per cent minus 200-mesh*. In mathematics, negative numbers have a definite and useful place. Obviously there can be no such thing as a sieve with minus 200 meshes per inch. We may consider that a plain sheet of metal without perforations is a sieve with zero meshes per inch. In this case, incorrect nomenclature has little or no merit even of convenience, because it is just as easy to say, in correct terms, *eighty per cent through 200-mesh*.

The Best Defense The best form of defense is a vigorous offensive attack, we are told in military circles; and in the more commonplace events of commerce and industry this same rule holds.

This, at least, seems to be the conclusion reached by a lead mining company in Missouri, where racketeering lawyers and doctors have been increasingly active in the silicosis racket—prosecuting claims against lead mining companies, cement manufacturing companies, and producers of commercial silica.

Now the Eagle-Picher Lead Co., of Joplin, Mo., has filed a suit against a Kansas City attorney, a Joplin doctor, and several other individuals, charging them with barratry and malicious conspiracy in connection with damage suits brought against the company by former employees.

The Pilot Knob Ore Co., of Ironton, Mo., likewise has taken action against two St. Louis attorneys, charging them with champerty and barratry in connection with damage suits brought against this company, claiming permanent injury from the occupational disease known as silicosis.

The results of these actions will be watched with interest by the cement manufacturing industry.

More Than a Theory The need for plant modernization may soon become more than a theory. Work-relief construction will soon be under way, at an accelerated rate. Private construction has shown a definite pick-up, significant examples being the recent contract for a large new steel mill in the Gary district and the big increase in private construction contracts throughout the South.

Cement will be in demand again; but plants that have not rehabilitated at least a part of their manufacturing units can not make it at a profit.

What Is Pozzolana?

Physical Characteristics and Chemical Composition—Amount of Soluble Silica No Index of Value—The Determining Clues

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UNDER the classification of the term "admixture" there are usually comprised a quantity of substances large in number and of varied physico-chemical characteristics; but the most widely advertised admixtures are those which have received the more specific designation of pozzolanic (pozzuolanic or puzzuolanic, according to the chosen spelling!).

The adjective pozzolanic is derived from the name pozzolana—a name with which everybody in the cement industry has become familiar of late, although very few claim to know what pozzolana really is. Without going into more elaborate details for the present, suffice it to say that pozzolana is a cementitious material found in the volcanic fields of Italy which, when mixed with slaked lime, furnishes a mortar capable of setting under water. This remarkable property was known to the inhabitants of Italy since the earliest periods of their history, a fact which can be attested by the remains of works pre-dating the Christian Era; and it was extensively and successfully utilized by the Romans in the building of all their hydraulic structures and of some of their greater non-hydraulic works.

Marvelous Durability

All these works, when not destroyed purposely by human agencies, have withstood marvelously the onslaught of natural elements, so that after two thousand years or more some of them are still in a perfect state of preservation. Such a statement can be corroborated by the testimony of many authorities like Vicat, for instance, who says, in "Annales des Ponts et Chaussées," Year 1862: "It is possible to refer to the constructions of various ports along the coast of Italy built by the Romans, those of Civitavecchia erected during the reign of Trajan, or those of Porto d'Anzio, of the times of Nero. Both works, immersed in the sea during many centuries, still present a physical resistance such that it is difficult to break fragments away from them. In the same splendid way the foundations of the temple of Neptune, about four miles

from Civitavecchia, are standing up, though totally immersed in the sea since the oldest times, being anterior to the Christian era. All these constructions made with pozzolana present masses of great strength; and their very existence after immersion in the sea for so many centuries is sufficient to prove the unalterability of the lime-pozzolana mortars." But this is not enough. Pozzolana mortars immersed in water, either fresh water or chemically aggressive waters, have been known actually to increase in physical strength and chemical resistance rather than to deteriorate with the passing of time.

This knowledge, coupled with the widespread belief of the insufficiency of the resistance of portland cement mortar and concrete to the action of chemically aggressive agents, and to the increasing advocacy of blended cements for this purpose, led to the present state of things in which pozzolanic admixtures have become the password for the manufacture of the best type of blended cements.

Now, if in each case this meant the addition of quantities of true pozzolana, the problem of producing pozzolanic blended cements would be greatly simplified; but nowadays all kinds of substances which have none of the properties of true pozzolana are sold under the name of pozzolanic admixture. Thus the problem of determining the behavior of pozzolana-blended cements is rendered more difficult. It is necessary, therefore, to go once for all into a more detailed analysis of the characteristics of pozzolana, so as to be able to know exactly what is pozzolana and to define the limits within which an admixture can be said to possess pozzolanic properties.

Physical Characteristics

The initial approach to the knowledge of pozzolana can be represented by a study of its physical characteristics. This study has been conducted mostly by Italian chemists like Professor O. Rebuffat, of the University of Naples; G. Giorgis; G. Gallo and U. Alvisi, of the University of Rome; F. Ferrari, of the University of Pisa, and Q. Sestini, of the

Polytechnic of Milan. The studies pursued by these men have definitely established that the constitution of pozzolana shows the following characteristics:

1. A physical state that is amorphous for the greatest portion of the mass, and crystalline for a small quantity of elements scattered throughout the amorphous mass.

2. A morphological structure of the amorphous mass, showing evidence of internal stresses within the single particles of a magnitude such as practically to destroy their molecular cohesion, the particles appearing, under the microscope, highly porous; or more exactly, filled with cavities occupying two-thirds of the whole volume.

3. Behavior of the material under the polarizing microscope indicating complete extinction of the amorphous part and slight double refrangency of the crystalline elements, these elements appearing under the ordinary microscope variously colored, being probably fragments of plagioclase, leucite, augite, pyroxene, etc.

4. A property of the particles of the amorphous mass that causes swelling when treated with an excess of lime water, giving birth to a precipitate of extraordinarily large volume, extremely rich in water.

5. An evidence of the existence, within the amorphous part, of free silica and of an alkaline silico-aluminate.

6. A property possessed by the free silica, when placed in the presence of slaked lime, causing the formation of a gel completely enveloping the particles of calcium hydrate, this gel undergoing a progressive hardening with its progressive dehydration.

7. A property shown by the alkaline silico-aluminate, when placed in the presence of slaked lime, causing it to combine slowly with lime and water, transforming itself into a low lime calcium silico-aluminate hydrate of a continuously increasing hydraulic cementitious value reaching its maximum after a long period of years.

8. A property of accelerating this reaction through a previous thermic treatment of the pozzolana.

9. A property evinced by the compounds formed through the reaction lime-pozzolana, of being able to lose again all the lime, when subjected to the action of chemically aggressive waters, without disintegrating or retrograding in physical resistance.

10. A property possessed by the lime-pozzolana reaction of being a distinctly endothermic one.

Given the above list of physical properties of a true pozzolana, it is easy to realize how slight is the possibility of finding materials which can be classified as pozzolanic. The difficulty can readily be appreciated when one thinks of the genesis of pozzolana.

As Professor O. Rebuffat says in his work "On Cements and Pozzolanas," Naples, 1932: "We have finally learned that not all volcanic sands can be good pozzolanas. Before a sand can be classed as pozzolanic, it is necessary that it present a vitreous structure and a chemical composition corresponding to that of determinate lavic magmas, either trachytic or basaltic, which contain sanidine, leucite, nefeline and other alkaline

silico-aluminates. In other words, pozzolana is constituted in its fundamental part of an alkaline silico-aluminate in a vitreous state. We can find in it appreciable percentages of lime, magnesia and ferrous and ferric oxides, but all these elements could even be missing without damage to the pozzolanic property, while the alkaline silico-aluminate can never be missing. When the lavic magma is suddenly projected into the atmosphere by an explosion of steam, its small particles, upon instantaneous cooling, remain in a vitreous state and acquire a reactivity of which the lavic rock is lacking in its ordinary form. In fact, if we succeed in fusing and then suddenly cooling sanidine, leucite or orthoclase, the vitreous substances attained may possess pozzolanic properties.

Vitreous or Crystalline Particles

It is easy to understand, then, how during the projection of the lavic magma into the atmosphere, the smaller particles, cooling much more rapidly, remain in a vitreous state, while the larger particles, either because they are only partially fused or because they have been cooled much more slowly, assume the crystalline state. We find, thus, that pozzolana is constituted of a mixture of vitreous parts (active as hydraulic cementitious material) and crystalline parts (inert as to hydraulic effect)."

The difficulty presented by the discovery of a substance which would evince a true pozzolanic nature increases still further when, from the consideration of physical properties, we pass to the consideration of chemical characteristics.

It would be interesting, in fact, to establish once and forever what the chemical composition of a true pozzolana should be; or at least, the chemical composition of the amorphous mass, which, during the process of hydration constitutes the binding matrix of a pozzolanic mortar.

Question of Oxide Analysis

Once we were, in fact, in possession of such data, we would have quite a source of help toward the identification of pozzolanic materials from the oxide analysis. Unfortunately, the chemical composition of pozzolanas varies between such wide limits that no help can be derived from the study of their oxide analysis, in the search for materials which through the analogy of chemical composition, could give a reasonable guaranty of being true pozzolanas. This

TABLE 1—OXIDE ANALYSES OF POZZOLANAS

Analysis Number	SiO ₂	Al ₂ O ₃	Fe ₂ O ₃	CaO	MgO	Na ₂ O	K ₂ O	H ₂ O and other substances; ignition loss
(1)	45.50	15.12	12.05	9.33	3.59	3.78	2.15	8.45
(2)	46.24	19.26	11.18	9.82	2.84	2.66	2.77	6.10
(3)	64.71	20.03	4.98	4.39	0.96	1.77	3.07	0.09
(4)	48.58	32.72	9.63	7.16	—	0.74	0.74	1.17
(5)	47.10	21.90	8.01	9.91	1.56	2.56	6.01	2.21
(6)	30.00	24.00	23.30	13.00	1.00	—	—	8.50
(7)	45.50	15.125	12.050	9.336	3.595	3.782	2.154	8.458
(8)	52.77	17.00	4.84	3.28	1.35	4.94	7.65	6.25
(9)	47.10	21.90	8.01	9.91	1.56	2.56	6.01	2.21
(10)	56.20	19.30	8.70	2.90	0.25	2.90	3.43	6.30
(11)	54.16	19.14	3.51	5.12	1.05	2.89	9.35	4.82
(12)	48.00	17.53	5.09	11.19	3.60	2.56	8.47	1.54
(13)	45.00	14.00	12.00	3.80	4.70	4.10	1.40	9.20
(14)	57.02	18.85	6.90	3.18	0.65	3.51	2.78	6.27
(15)	44.00	10.50	29.50	10.00	Trace	—	—	2.50
(16)	44.50	16.50	15.00	10.00	3.00	—	—	3.00
(17)	42.50	15.50	12.50	9.50	4.40	—	—	3.33
High value	64.71	32.72	29.50	13.00	4.70	4.94	9.35	9.20
Low value	30.00	10.50	3.51	2.90	Trace	0.74	0.74	0.09

Analyses numbers (1) to (5), inclusive, are from G. Gallo, "The Microscopic Study of Pozzolanic Mortar."

Analyses numbers (6), (7) and (10) are from G. Giorgis and U. Alvisi, "Natural and Artificial Pozzolanas."

Analyses (8) and (9) are from Professor O. Rebuffat, "Studies upon the Technical Analysis of Pozzolana."

Analysis (11) is by Professor O. Rebuffat.

Analysis (12) is from G. Giorgis and U. Alvisi, "Contribution to the Study of Pozzolana and Its Technical Value."

Analysis (13) is by L. J. Vicat.

Analysis (14) is from F. Ferrari, "Of Special Cements in Connection with the Action of Aggressive Waters."

Analyses (15) to (17), inclusive, are by L. J. Vicat.

can be seen from a study of chemical analyses of various types of pozzolanas, the results of which are shown in Table 1.

The analysis recorded in Table 1 should be sufficient to prove definitely that the chemical composition can not be regarded as a safe index of pozzolanic nature, because this composition may vary between wide limits, without this variation having any sensible effect upon the pozzolanic action. As M. L. Montaut, a French engineer, says in his "Memoire sur la Pouzzolane Naturelle de Santorin," published in "Annales des Ponts et Chaussees, 1862": "The chemical composition of the pozzolana of Santorin is not sufficient to explain completely the phenomena accompanying its mixing with slaked lime, mixing which gives birth to a mortar capable of setting under water. There are, in fact, substances of analogous chemical composition which do not enjoy this property, and the pozzolana of Santorin itself loses its hydraulic value whenever it has been fused and then ground to an extremely fine powder."

Soluble Silica Not an Indicator

Furthermore, while it is generally believed that it is possible to express the hydraulic value of a pozzolana as a simple relationship of the amount of soluble silica appearing in the oxide

analysis, it happens, regrettably, that the pozzolanic property is not related at all to the amount of soluble silica present in a material, and that, often, the one with the least amount of soluble silica will furnish the best pozzolana.

To substantiate these statements, I am reproducing, in Table 2, analyses of pozzolanas made by some of the leading Italian experts. The amount of soluble silica present is shown in each case.

The analyses recorded in Table 2 plainly show that the acid-soluble silica may vary from a maximum of 21.57 of the very mediocre pozzolana of Can-

TABLE 2—ANALYSES OF POZZOLANAS

	Analysis Number		
	(1)	(2)	(3)
SiO ₂ { Soluble	10.04	21.57	0.525
{ Insoluble	42.73	32.59	44.975
Al ₂ O ₃ (Combined soluble and insoluble)	17.00	19.14	—
Al ₂ O ₃ { Soluble	—	—	14.925
{ Insoluble	—	—	0.200
Fe ₂ O ₃	4.84	3.51	12.050
CaO	3.28	5.12	9.336
MgO	1.35	1.05	3.595
K ₂ O	—	9.35	2.154
Na ₂ O	—	2.89	3.782
Combined alkalis	13.51	—	—

Analyses (1) and (2) are from O. Rebuffat's "Analysis of a Pozzolana," Naples, 1910.

Analysis (3) is from G. Giorgis and U. Alvisi, in "Natural and Artificial Pozzolanas."

TABLE 3—SOLUBLE ANALYSES OF POZZOLANAS

	Analysis No.	
	(1)	(2)
SiO ₂	4.89	13.31
Al ₂ O ₃ plus Fe ₂ O ₃		12.80
Al ₂ O ₃ alone	1.77	
Fe ₂ O ₃ alone	0.68	
CaO	1.22	
MgO	0.20	
Total soluble	8.76	26.11
Total insoluble	85.69	63.16
Loss on ignition	5.55	10.73

100.00 100.00

Both analyses are from O. Rebuffat's "Studies of the Technical Analysis of Pozzolana," Naples, 1896.

TABLE 4—ANALYSES OF POZZOLANA FROM ISLAND OF SANTORINO

	Analysis Number		
	(1)	(2)	(3)
SiO ₂ { Soluble	Trace	0.00	0.00
SiO ₂ { Insoluble	66.37	66.96	64.34
Al ₂ O ₃ { Soluble	1.36	5.91	5.83
Al ₂ O ₃ { Insoluble	12.36	7.20	5.05
Fe ₂ O ₃	4.31	5.42	6.44
CaO	2.98	2.46	3.62
MgO	1.29	1.03	
MnO ₂		0.83	
MgO plus MnO ₂			2.77
K ₂ O	2.83	3.23	4.83
Na ₂ O	4.22	4.81	6.05
Loss on ignition	4.06	1.55	1.50

neto, found in the neighborhood of Naples, to a minimum of 0.525 in the best Roman pozzolana, called Pozzolana of San Paolo, without, for that matter, bringing about that corresponding variation in the hydraulic qualities of a pozzolana assumed generally by all current writers on pozzolanic admixtures.

Conclusive, above all, on this subject is the analysis of that variety of pozzolana found on the island of Santorino, which is one of the Cyclades Islands in the Aegean sea. This variety of pozzolana, which is perhaps the most active of all, shows some alumina soluble in hydrochloric acid, but no acid-soluble silica at all! Table 4 shows three analyses of this material reported from the work of G. Giorgis and U. Alvisi, "Natural and Artificial Pozzolanas."

A tentative explanation of this discrepancy existing between soluble silica and hydraulic value of a pozzolanic material is offered by M. L. Montaut in his previously mentioned "Memoire sur la Pouzzolane Naturelle de Santorin," in "Annales des Ponts et Chaussees" for the year 1862. In this memoire he says: "It must be remarked that hydrochloric acid, which does not dissolve more than a negligible part of the pozzolana of

Santorino, can not attack the silica which this type of pozzolana contains in considerable quantity. It must be, then, that the silica in it plays the role of silicic acid, forming acid silicates, while in trass or in the pozzolanas of Italy the silica exists in the state of salt, either neuter or basic. From all this it follows that by treating the pozzolana of Santorino with diluted hydrochloric acid, this acid combines with the bases with which the silicic acid was combined, liberating a notable quantity of silicic acid."

Best Pozzolanas Devoid of Soluble Silica

Whatever may be the reason for this variable percentage of soluble silica, we shall put the investigation of this reason aside for a while and follow the thread of a possible relationship between soluble silica and hydraulic value of a pozzolana. By the comparative examination of the oxide analyses of Italian pozzolanas and of Santorino we would be brought to the amazing conclusion (diametrically opposed to the one currently held) that the less soluble silica is present the more valuable a pozzolana becomes. In fact, passing from the inferior Neapolitan pozzolanas to the better ones, then, successively, to the average Roman pozzolanas and the best Roman pozzolanas, and finally to that of Santorino, which appears to be preferable to all the others, we find, as we have said, an increasing reduction of the amount of soluble silica. There is a wide range from the quite considerable values of some Neapolitan pozzolanas to zero value for that of Santorino.

But the best proof that there is no relationship whatever between soluble silica and hydraulic value of a pozzolana will be afforded by the analyses of the weakest of all forms of pozzolana—the one found in Germany, mostly in the neighborhood of the Rhine, and in

some localities of Holland and France, generally known under the German name of trass.

Of this type of pozzolana, the varieties from Holland and France, which in their hydraulic cementitious values lag far behind the pozzolana of the Island of Santorino, or even the Roman or Neapolitan ones, ought to be, according to the criterion of the relationship (soluble silica = hydraulic cementitious value), the best of all pozzolanas, because they show the largest amount of soluble silica. Instead, it happens that the best trass is the German variety, which again shows the least soluble silica.

Table 5 gives the results of numerous analyses of these substances reported in the often-cited monograph "Natural and Artificial Pozzolanas," by G. Giorgis and U. Alvisi.

Finally, it has been clearly recognized by all European cement experts that there is no relationship whatever between soluble silica and hydraulic cementitious value of a pozzolanic substance. Thus the researches of the German Society for Testing Materials end with the statement: "Neither the complete chemical analysis nor the soluble silica content gives a positive indication of the quality of trass in a mortar." (Tonindustrie Zeitung, Volume 56—Pp. 993-995.) Likewise, G. Giorgis and U. Alvisi end their years of research in pozzolana with the statement (See "Contribution to the study of Pozzolana and its technical value," by G. Giorgis and U. Alvisi in Gazzetta Chimica Italiana, Year 1906, Volume 36): "One thing appears evident: It is wrong to suppose that a criterion of the hydraulic quality of a pozzolanic material can be based solely upon the quantity of silica soluble in potassium hydrate either by a previous attack with an acid or with the direct action of the potassium hydrate itself."

TABLE 5—ANALYSES OF TRASS FROM HOLLAND, FRANCE AND GERMANY

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
SiO ₂ { Soluble	28.00	23.00	17.00	31.00	22.50	11.50	5.15	14.50	10.60	8.20
SiO ₂ { Insoluble	29.50	31.00	37.40	23.00	33.00	37.44	46.93	42.30	48.70	44.00
Al ₂ O ₃ { Soluble	5.00	6.00	11.15	11.00	11.00	17.70	16.02	8.30	6.10	5.20
Al ₂ O ₃ { Insoluble	5.10	10.50	7.00	6.00	5.00	1.25	2.26	8.30	6.10	10.00
Fe ₂ O ₃	3.90	6.10	4.50	6.00	4.50	12.34	3.81	9.40	6.50	11.40
CaO	7.70	4.00	2.00	2.60	2.60	5.41	1.25	8.30	6.20	6.70
MgO	1.10	0.70	3.00	1.00	3.40	2.42	1.31	2.20	1.90	2.50
K ₂ O plus Na ₂ O	6.40	10.00	7.00	10.00	6.60					
K ₂ O alone						0.37	4.17	2.10	3.60	4.10
Na ₂ O alone						3.56	3.44	1.10	3.30	2.60
Loss on ignition	12.60	7.70	10.20	8.00	10.50	7.65	12.65	2.80	5.50	6.10

Analyses (1) and (2) are of trass from Holland; analyses (3), (4) and (5) are of trass from France; and analyses (6), (7), (8), (9) and (10) are of trass from Germany.

Statements such as these can be justified only when, following the thought of L. Montaut, we consider that the whole question of the amount of soluble silica shown in the oxide analysis hinges upon the possibility of the silica being combined with bases, forming thus basic salts. Whenever that happens, in fact, the acid used in the analysis displaces the much weaker silicic acid in all the basic salts, combining with the bases and liberating some or all of the silica present. Whenever, instead, the silica is combined under the form of acid silicates, either in its total amount, as in the case of Santorino pozzolanas, or partially, as in the case of Italian pozzolanas and trass, the amount of soluble silica shown in the oxide analysis is either lacking altogether, or reduced to a fraction of the total silica.

No better clue toward the discovery of the pozzolanic nature of a material can be afforded by accelerated tests furnishing, within a relatively short time, an indication of the magnitude and the progress of the lime-pozzolana reaction. This type of tests, initiated by Vicat and continued by Rivot, Rebuffat, Giorgis, etc., has not been found successful in producing satisfactory results.

Neither a test of the cementing qualities of a certain substance used as cementitious material, alone or mixed with sand or gravel, furnishes any safe indication of its pozzolanic nature. We find, in fact, that true pozzolana in its natural state is not a cement at all, when mixed with water. Without addition of lime or of natural or artificial cement, it fails to harden, and whatever slight set it may evince is due simply to a

small amount of lime present in its mass as free calcium oxide.

This failure of pozzolana to behave as a hydraulic cement is due again to the fact that the chemical compound which is responsible for the hardening of hydrated pozzolana must be transformed, through its reaction with lime, into an entirely different substance before this hardening can ever take place.

The Determining Clues

The fact, then, that a certain substance in its natural state possesses high cementitious qualities must be assumed as furnishing no evidence whatever that the substance is a true pozzolanic material. Also, the fact that a finely divided material containing large numbers of particles of colloidal size is capable, when placed in suspension in a lime-water solution, of reducing the concentration of lime, can not be assumed to furnish an evidence of pozzolanic nature of that material. Pozzolanic activity expresses itself, as previously stated, through the birth of chemical reactions of pozzolana and lime. But in the case of materials containing particles of colloidal size immersed in lime water, the apparent reduction in lime concentration of the solution is not the resulting effect of chemical combinations; it is rather the resulting effect of a mechanical fixing of the lime molecules by the colloidal particles, a phenomenon which has received the name of *adsorption* in treatises on colloid chemistry. It is thus that the two phenomena, although being apparently the same thing, are in reality two different things, both in causes and

effects. We are left, thus, at the end of our examination of the physical and chemical characteristics of pozzolana, with only two definite clues as to the possibility of discovering true pozzolanic materials. These clues are:

1. A fulfillment of the required physical characteristics of a true pozzolana.
2. A chemical composition showing an oxide analysis such that (a) the combined percentage of silica and alumina averages between 50 and 80 per cent of the total; (b) there is always present a certain quantity of alkalies, because they are a part of that alkaline silica-aluminate which forms the matrix of the amorphous mass.

Now it is evident that the physical requirements are, in a certain way, the decisive ones, because although some of the admixtures which at present go under the name of "pozzolanic" come quite within the limits of the chemical analysis, there is none which fulfills all the requirements of the necessary physical characteristics.

Such being the facts, it is interesting to follow the course of the reactions of a true pozzolanic substance and a non-pozzolanic substance when they are used, as admixtures for portland cement, or as elements of lime mortars, so as to be able to compare the phenomena which characterize these reactions, and determine whether or not they are in any way similar; and if they are not similar, whether or not it is permissible to use non-pozzolanic admixtures in place of true pozzolanic ones.

Masonry Cements Investigated

Report of Bureau of Standards Issued as a Separate Pamphlet

AN investigation of commercial masonry cements conducted by the National Bureau of Standards has been reported in a 40-page pamphlet issued by the Bureau as *Research Paper RP-746*. The authors of the report are Jesse S. Rogers and Raymond L. Blaine. The report appears also in the *Journal of Research* of the National Bureau of Standards, Vol. 13, December, 1934.

Forty-one commercial masonry cements were studied with respect to chemical composition, fineness, weight per unit volume, volumetric flow, and bulk specific gravity, while mortars made

from those cements were tested thoroughly.

It was found that the 41 cements could be classified as (1) hydraulic limes, (2) hydrated limes, (3) natural cements, (4) blast-furnace slag cements with various additions, (5) several cements whose composition could not be positively determined, or (6) portland cements with and without admixtures, the quantities of which varied from small amounts to amounts larger than the quantity of portland cement. About half the cements studied contained water-repellent additions.

Physical properties of the mortars varied over a wide range of values. For example, the weight of the cements varied from 39.7 to 39.9 lb. per cu. ft. The compressive strength of the 1:3 mortars, when tested at the age of 28 days, ranged from 50 to 3,650 lb. per sq. in. The addition of water-repellent material strikingly affected the properties of mortars made from cements to which such additions had been made. The workability, particularly, seemed to be increased, due to the incorporation of air in the mortar during mixing, caused by the water-repellent additions acting as emulsifying agents.

Copies of the report may be obtained at 5 cents each, from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Men and Mills

[News of and for
Cement Mill Men]

A clearing-house page for all kinds of news about cement men and cement mills. ☐ Readers in all mills, even though not regular contributors, are invited to

send in news notes about personal and plant activities that may be of interest or value to the men in other mills.

Moyle Entertained by Associates



Richard Moyle, Sr.

A well-earned tribute was paid to Richard Moyle, Sr., on the evening of March 25, by his associates of the Marquette Cement Manufacturing Co., in honor of his sixty-seventh birthday.

The event was staged in the form of a dinner in a private dining room in

the Palmer House, Chicago, with music furnished by a professional orchestra. Because Mr. Moyle is a native of England, the musical program was entirely of English music, some of it dating back to his childhood.

A striking feature of the dinner was an elaborately engraved program containing a portrait of Mr. Moyle, the dinner menu, the musical program, and the names of the twenty-two guests, all of whom are connected with the Marquette organization.

Lehigh Portland Cement Company, for twelve months ended March 31, 1935, reports net profit of \$663,590 after all charges and obsolescence, equal to \$4.46 a share on the 7 per cent preferred, against net loss of \$434,407 in twelve months ended March 31, 1934.

The Manitowoc Portland Cement Company of Manitowoc, Wisconsin, is operating at two thirds capacity after being idle since last fall, and expects to have all three kilns operating soon.

The plant is giving employment to approximately 150 hands and will continue on a 24-hour a day basis working three shifts of eight hours each.

The Medusa Portland Cement plant at Bay Bridge, five miles west of Sandusky, Ohio, is expected to resume operations about May 1st after being completely shut down since October 1, A. J. Little, superintendent, said on April 2.

Re-opening of the plant will mean the re-employment of approximately 175 men.

R. M. Simrall, formerly district engineer at Kansas City for the Portland Cement Association, and later connected with the Philip Carey Company, of Cincinnati, has returned to the association to engage in concrete highway promotion. His headquarters will be at the general office of the association in Chicago.

Alpha Portland Cement Co., for the year ended December 31, 1934, shows consolidated net loss of \$162,767 after taxes, depreciation, depletion, minority interest, etc., comparing with net loss of \$604,960 in 1933.

Current assets as of December 31, 1934, including \$4,146,909 cash, government and other marketable securities, amounted to \$5,485,651 and current liabilities were \$404,036.

The Dewey Portland Cement Company resumed operations on April 15, D. M. Tyler, vice-president and general manager, announced recently.

Better business conditions in the cement industry, coupled with completion of machinery, repairs and plant improvements are responsible for resumption of full time work.

The decision means that approximately 125 employes will again receive steady employment. The plant employs about 350 men.

Charles Boettcher, president of *Ideal Cement Co.*, Denver, and widely-known business man, has been elected to the board of directors of the *Cache La Poudre Co.*

All 1934 officers and directors of the *Lehigh Portland Cement Company*, Allentown, Pennsylvania, were re-elected as follows:

Joseph S. Young, president; Daniel E. Ritter, vice-president and general manager; B. L. Swett, vice-president and eastern sales manager; B. H. Rader, of Chicago, vice-president and western sales manager; R. R. Bear, vice-president and chief engineer; John C. Bowen, vice-president and assistant eastern sales manager; John C. Shumberger, controller; H. R. Hausman, assistant vice-president and assistant general manager; C. C. Long, secretary; C. E. Bowman, assistant secretary and assistant treasurer; C. H. Wescoe, assistant secretary and assistant treasurer; K. J. Schatzlein, assistant secretary and assistant treasurer; J. J. Hornung, of Chicago, assistant treasurer.

Directors re-elected were: George K. Mosser, Robert A. Young, B. F. Fackenthal, Jr., Daniel E. Ritter and Joseph S. Young.

An engineer from the *Lehigh Portland Cement Company* was in charge of a school of concrete instructions—including the fundamentals of good concrete, use of forms and reinforcements, estimating quantities and proportions of aggregates for concrete construction, and suggestions for dairy improvements on farms—late in February before the young people's activity group, a division of the Effingham (Illinois) county farm bureau numbering about 200 members.—*Decatur, Ill., Review.*

Monolith Portland Cement Company reports for the year ended December 31, last, net profits of \$84,227.40 after charges and Federal income taxes. This is equal to 57 cents a share on 146,446 shares of 8 per cent cumulative \$10 par value stock outstanding and compares with \$143,751, or 12 cents a share, on 223,724 common shares after preferred dividend requirements in the preceding year.

Net sales were \$1,655,533, compared with \$1,527,442 in 1933.

At the annual meeting of the company on March 12, directors were re-elected as follows: Roy Burnett, A. F. Smith, H. B. Reed, I. M. Jameson, A. L. Black, G. L. Reynolds and C. R. Taylor.

Announcement was made recently that the *Universal Atlas* cement plant at Ilasco reopened February 1. The plant has been closed since November 1.

Edward J. Mehren, president of the *Portland Cement Association*, Chicago, addressed the luncheon meeting of the Kiwanis Club at the Hamilton Club on March 7 on the subject, "Can We Unblock the Machine Age?"—*Chicago, Ill., News.*

Diversion of taxes collected from motorists from its intended purpose—construction and maintenance of highways—was explained before the Kenosha (Wisconsin) Round Table club recently in a unique program presented by E. E. Brevik, of Milwaukee, a representative of the Portland Cement Association.

This "talkie" program, cement men should remember, can be obtained from the general office of the P. C. A. for use at business men's meetings of this type.

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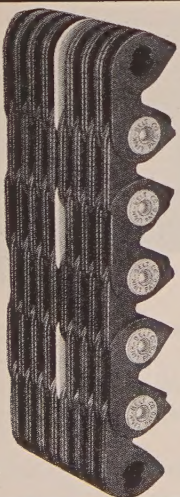
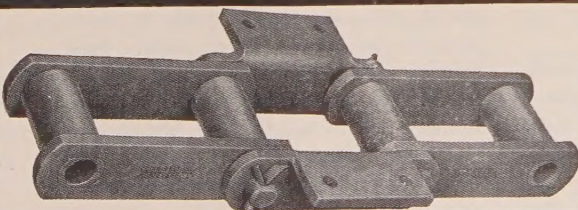
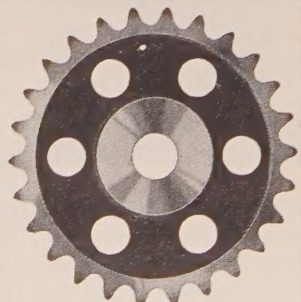
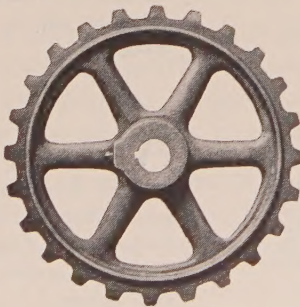
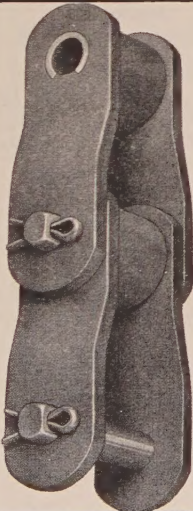
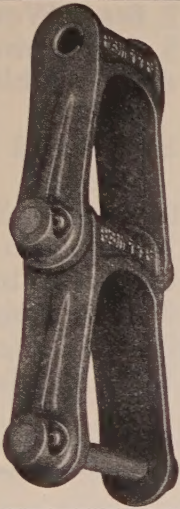
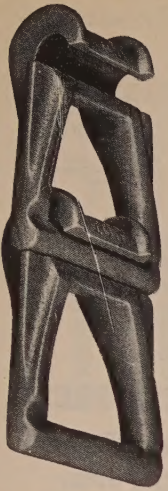
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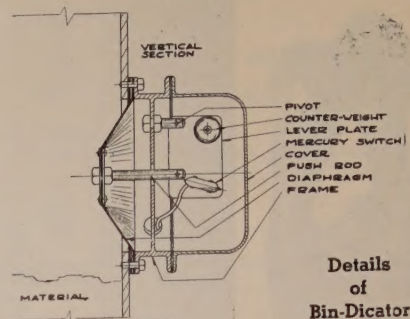
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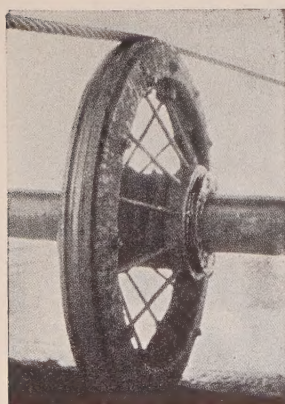


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MILL EQUIPMENT

MURRAY-CORNISH rubber-faced rollers and sheaves, recently announced by the D. J. Murray Mfg. Co., Wausau, Wisconsin, are recommended by the makers for their smooth operation and dependability,



Rubber
faced
sheave
in
operation

resulting in savings on rope and power with a low maintenance cost. The sheave is fitted with anti-friction bushings so that the least amount of power is required to turn it over and at the same time there is no slippage of cable on the face of the

sheave to cause wear when the cable is stopped or reversed, the makers say.

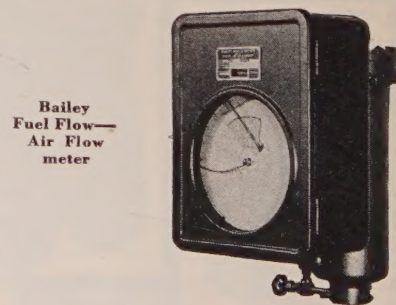
The sheaves come in standard sizes—21, 30 and 48 in. diameter—but special diameters can be made. The sheaves are designed for proper sections and strength, made of high-test cast iron, with rubber facing in one solid piece for the smaller diameters and in segments for the larger diameters.

A NEW Fuel Flow—Air Flow meter, recently developed by Bailey Meter Company, Cleveland, Ohio, guides operators of furnaces and kilns so that they are able to obtain combustion efficiency from the fuel burned.

The primary purpose of the meter is to provide furnace operators with an easily understandable guide which enables them to maintain a definite relation between the amounts of air and fuel supplied to the furnace, thereby securing the highest possible combustion economy. The meter contains two recording pens, one records the rate of oil or gas flow and the second pen

records the flow of air supplied for combustion.

TRAYLOR Type TY reduction crusher is a brand-new "little brother" of the Traylor Type TZ reduction crusher offered by the Traylor Engineering & Mfg. Co., Allentown, Pa.



Bailey
Fuel Flow—
Air Flow
meter

This crusher is said to be extremely compact and of very sturdy construction, with an all cast-steel frame and having the spider, hopper and top shell cast in one piece.

This machine has been designed for operators of the smaller crushing plants.